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Environmental Effects of Timber Harvesti
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THE ENVIRONMENTAL EFFECTS OF TIMBER HARVESTING IN ALBERTA



Alberta

LANDS AND FORESTS

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THE ENVIRONMENTAL EFFECTS
OF TIMBER HARVESTING OPERATIONS
IN THE
EDSON AND GRANDE PRAIRIE FORESTS OF ALBERTA



VOLUME 2 **A**

PROJECT REPORT

SEPTEMBER 1973

For

THE MINISTER OF LANDS AND FORESTS
GOVERNMENT OF ALBERTA
Edmonton, Canada

By

C.D. SCHULTZ & COMPANY LIMITED
Vancouver, Canada

APPENDICES

CHAPTER 11
CHAPTER 111
CHAPTER V



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APPENDICES

CHAPTER II



SCHULCO

APPENDIX II-1

MEAN PRECIPITATION

APPENDIX II-1

MEAN PRECIPITATION

E = Estimate

<u>Station</u>	<u>Seasonal (May-September)</u>	<u>Annual</u>	<u>Elevation (in ft.)</u>
Adams Creek LO	13.06" E	-	7250
Ansell Lo	15.30"	-	3140
Athabasca LO	15.95"	-	5350
Bald Mountain LO	13.62"	-	3080
Berland LO	16.44"	-	4000
Copton LO	14.10" E	-	6088
Economy LO	13.55"	-	2625
Edson A	14.61"	21.81"	3035
Entrance	13.11"	20.22"	3300
Grande Prairie A	9.82"	17.40"	2190
Grave Flats LO	20.00" E	-	6804
Hinton	14.30"	19.40"	3325
Huckleberry LO	15.60"	-	4688
Jasper	8.46"	15.84"	3480
Kakwa LO	16.01"	-	3980
Lovett LO	18.46"	-	4740
Mayberne LO	16.48"	-	4890
Moberly LO	14.08"	-	5404
Muskeg Ranger Station	12.82"	20.95"	4025
Nordegg Ranger Station	15.45"	-	4350



<u>Station</u>	<u>Seasonal (May-September)</u>	<u>Annual</u>	<u>Elevation (in ft.)</u>
Nose Mountain LO	17.25" E	-	5165
Obed LO	17.82"	-	5200
Pass Creek LO	15.48"	-	3725
Pinto LO	15.92"	-	3500
Robb Ranger Station	15.82"	24.90"	3708
Simonette LO	16.71" E	-	4180
Smoky LO	18.49"	-	3800
Snuff Mountain LO	13.87"	-	3180
South Wapiti Ranger Station	13.21"	23.29"	2500
Tom Hill	15.56"	-	4250
Tony LO	17.11"	-	3400
Torrens LO	16.46" E	-	6000
Yellowhead LO	17.02"	-	4800



APPENDIX II-2

SPECIES COMPOSITION OF MAJOR PLANT COMMUNITIES



APPENDIX II-2

SPECIES COMPOSITION OF MAJOR PLANT COMMUNITIES

(a) Recently Burned

Overstory - Absent

Understory - Absent

Shrub - Pine, spruce seedlings, poplar, birch, alder, willows, rose, wild raspberry, red osier dogwood

Ground - Conifer seedlings, fireweed (Epilobium angustifolium), lichens (Cladonia spp.), mosses (Ceratodon, Rhytidiadelphys, Hypnum, Hylocomium, Polytrichum spp.), wild strawberry, aster, everlasting, grasses, wild rye, bedstraw, twinflower, cornus

(b) Recently Harvested

Overstory - Absent, except for residual poplars

Understory - Undestroyed coniferous and deciduous saplings

Shrub - As in (a) but often with previously suppressed conifers and rapidly spreading shrub species

Ground - As in (a) but often more varied and with fewer conifer seedlings

(c) Deciduous Forest

Overstory - Aspen (Populus tremuloides), balsam poplar (P. balsamifera), birch (Betula papyrifera)

Understory - Absent or immature spruce (Picea glauca)



- Shrub - Rose, snowberry, alder, red osier dogwood, willow
- Ground - Grasses, strawberry, bedstraw, dewberry, aster, bunchberry, wintergreen. Advanced under open or decadent overstory.

(d) Mixedwood Forest

- Overstory - Aspen, pine, spruce
- Understory - As in (c)
- Shrub - As in (c)
- Ground - As in (c), but with more mosses, and lichens

(e) Pine Forest

- Overstory - Pine (P. contorta)
- Understory - Spruces (Picea glauca, P. mariana)
- Shrub - Rose, alder, raspberry, buffalo berry, vaccinium (often sparse)
- Ground - Labrador tea (Ledum groenlandicum), bunchberry (Cornus canadensis), horsetail (Equisetum sylvaticum), wintergreen, feather mosses, leafy lichens

(f) Spruce-pine Forest

Species composition midway between (e) above and (g) below.

(g) Spruce-fir Forest

- Overstory - Spruces (Picea glauca and engelmannii), alpine fir (Abies lasiocarpa)
- Understory - Spruce and fir saplings

- Shrub - Spruce and fir seedlings, willow, alder, mountain ash, rose, spiraea - commonly sparse
- Ground - Labrador tea, ferns, grasses, equisetum, copious mosses and lichens, and a large list of herbs

(h) Riparian

- Overstory - Absent
- Understory - Balsam poplar, willow, alder, dwarf birch (B. glandulosa), red osier dogwood
- Ground - Hydrophylic sedge grasses, reeds, etc.

(i) Bogs

- Overstory - Black spruce, tamarack (Larix laricina)
- Understory - Stunted specimens of same species
- Shrub - Bog birch (Betula glandulosa), willow
- Ground - Labrador tea, sphagnum moss, bog cranberry, dewberry

(j) Alpine (areas above timberline, with vegetation influenced by climate)

- Boulder-field Salix, Poa, Sibbaldia
- Fell-field Dryas, Silene, grasses, sedges
- Alpine meadow Grasslands (Poa, Agrostis, Festuca), and herbage (Dryas, Sibbaldia, Saxifraga)
- Heath Cassiope, Phyllodoce, Pedicularis, Saxifraga
- Snow-patch flora Erythronium, Anemone, Ranunculus, Valeriana, Carex
- Alpine bog Salix, Carex

APPENDIX II-3

SMALL MAMMALS ON OR NEAR PROJECT AREA

APPENDIX II-3

SMALL MAMMALS ON OR NEAR PROJECT AREA

SPECIES	ABUNDANCE	
	<u>MOUNTAIN REGION</u>	<u>GRANDE PRAIRIE REGION</u>
Cinereous Shrew (<u>Sorex cinereus</u>)	R	R
Dusky Mountain Shrew (<u>Sorex vagrans</u>)	VR	
Water Shrew (<u>Sorex palustris</u>)	R	VR
Northwestern Long-legged Bat (<u>Myotis volans</u>)	VR	
Little Brown Bat (<u>Myotis lucifugus</u>)		VR
Marten (<u>Martes americana</u>)	C	U
Fisher (<u>Martes pennanti</u>)	R	VR
Weasel (<u>Mustela erminea</u>)	C	C
Least Weasel (<u>Mustela rixosa</u>)	R	R
Mink (<u>Mustela vison</u>)	C	U
Wolverine (<u>Gulo luscus</u>)	R	VR
Otter (<u>Lutra canadensis</u>)	VR	VR
Skunk (<u>Mephitis mephitis</u>)	MC	MC
Red Fox (<u>Vulpes fulva</u>)	MC	MC
Coyote (<u>Canis latrans</u>)	MC	MC
Timber Wolf (<u>Canis lupus</u>)	U	MC
Cougar (<u>Felis concolor</u>)	U	
Lynx (<u>Lynx canadensis</u>)	MC	MC
Woodchuck (<u>Marmota monax</u>)		C
Hoary Marmot (<u>Marmota caligata</u>)	MC	



SCHULCO

SPECIES	ABUNDANCE	
	<u>MOUNTAIN REGION</u>	<u>GRANDE PRAIRIE REGION</u>
Mantled Ground Squirrel (<u>Citellus lateralis</u>)	U	
Columbian Ground Squirrel (<u>Citellus columbianus</u>)	MC	
Chipmunk (<u>Eutamias minimus</u>)	C	C
Red Squirrel (<u>Tamiasciurus hudsonicus</u>)	VC	U
Flying Squirrel (<u>Glaucomys sabrinus</u>)	U	U
Beaver (<u>Castor canadensis</u>)	C	U
White-footed Mouse (<u>Peromyscus maniculatus</u>)	VC	U
Wood Rat (<u>Neotoma cinerea</u>)	C	C
Lemming Vole (<u>Synaptomys borealis</u>)	R	
Red-backed Vole (<u>Clethrionomys gapperi</u>)	MC	MC
Meadow Vole (<u>Microtus pennsylvanicus</u>)	C	MC
Muskrat (<u>Ondatra zibethicus</u>)	MC	U
Jumping Mouse (<u>Zapus princeps</u>)	R	R
Porcupine (<u>Erethizon dorsatum</u>)	MC	U
Pika (<u>Ochotona princeps</u>)	MC	
Snowshoe Hare (<u>Lepus americanus</u>)	C	R

Observations of small mammals reported by Soper (1947, 1948) in the mountainous and lower elevation regions of the study area (VC = very common, C = common, MC = moderately common, U = uncommon, R = rare, VR = very rare).

APPENDIX II-4

CHECKLIST OF BIRDS ON PROJECT AREA



APPENDIX II-4

CHECKLIST OF BIRDS
ON PROJECT AREA

SPECIES	ABUNDANCE ¹	HABITAT TYPE ²							
		A	B	C	D	E	F	G	H
Common loon (<u>Gavia immer</u>)	R								⊕
Red-necked grebe (<u>Podiceps grisegena</u>)	MC								⊕
Horned grebe (<u>Podiceps auritus</u>)	R								x
Eared grebe (<u>Podiceps caspicus</u>)	C								x
Western Grebe (<u>Aechmophorus occidentalis</u>)	U								x
American bittern (<u>Botaurus lentiginosus</u>)	R							x	
Whistling swan (<u>Olor columbianus</u>)	M								x
Trumpeter swan (<u>Olor buccinator</u>)	U								x
Canada goose (<u>Branta canadensis</u>)	C								x
Snow goose (<u>Chen hyperborea</u>)	M								x
Mallard (<u>Anas platyrhynchos</u>)	C								⊕
Gadwall (<u>Anas strepera</u>)	U								x
Pintail (<u>Anas acuta</u>)	R								x
Green-winged teal (<u>Anas carolinensis</u>)	R								x
Blue-winged teal (<u>Anas discors</u>)	MC								⊕
American widgeon (<u>Mareca americana</u>)	C								⊕
Shoveler (<u>Spatula clypeata</u>)	C								x
Redhead (<u>Aythya americana</u>)	U								x
Canvasback (<u>Aythya valisineria</u>)	U								x
Lesser scaup (<u>Aythya affinis</u>)	C								x
Common goldeneye (<u>Bucephala clangula</u>)	C								x
Barrow's goldeneye (<u>Bucephala islandica</u>)	R								x
Bufflehead (<u>Bucephala albeola</u>)	C								⊕
Harlequin duck (<u>Histrionicus histrionicus</u>)	MC								x
White-winged scoter (<u>Melanitta deglandi</u>)	C								x
Ruddy duck (<u>Oxyura jamaicensis</u>)	MC								x
American merganser (<u>Mergus merganser</u>)	R								x
Hooded merganser (<u>Lophodytes cucullatus</u>)									⊕
Goshawk (<u>Accipiter gentilis</u>)	U		x	x	x	x			
Sharp-shinned hawk (<u>Accipiter striatus</u>)	U	x	⊕	x	x	x			



SPECIES	ABUNDANCE ¹	HABITAT TYPE ²							
		A	B	C	D	E	F	G	H
Red-tailed hawk (<u>Buteo jamaicensis</u>)	MC	⊕	⊕	x	⊕	x			
Broad-winged hawk (<u>Buteo platypterus</u>)	VR	x	x	x					
Swainson's hawk (<u>Buteo swainsoni</u>)	U					x			
Golden eagle (<u>Aquila chrysaetos</u>)	MC					x	x		
Bald eagle (<u>Haliaeetus leucocephalus</u>)	R	x	x	x		x			x
Marsh hawk (<u>Circus cyaneus</u>)	C					x		x	
Peregrine falcon (<u>Falco peregrinus</u>)	U					⊕			x
Pigeon hawk (<u>Falco columbarius</u>)	U	x	x	x					
Sparrow hawk (<u>Falco sparverius</u>)	MC				⊕	x			
Blue grouse (<u>Dendragapus obscurus</u>)	MC	x			x				
Spruce grouse (<u>Canachites canadensis</u>)	C	⊕	x						
Ruffed grouse (<u>Bonasa umbellus</u>)	C		x	x	x				
White-tailed ptarmigan (<u>Lagopus leucurus</u>)	C						x		
Sharp-tailed grouse (<u>Pedioecetes phasianellus</u>)	MC				x	x		x	
Ring-necked pheasant (<u>Phasianus colchicus</u>)	R					x			
Sandhill crane (<u>Grus canadensis</u>)	M					x		x	x
Sora rail (<u>Porzana carolina</u>)	R							x	
Coot (<u>Fulica americana</u>)	C							x	x
Semipalmated plover (<u>Charadrius semipalmatus</u>)	M								
Killdeer (<u>Charadrius vociferus</u>)	C				⊕	x	x		
Spotted sandpiper (<u>Actitis macularia</u>)	MC				⊕				⊕
Solitary Sandpiper (<u>Tringa solitaria</u>)	U							x	x
Lesser yellowlegs (<u>Totanus flavipes</u>)	C							x	x
Short-billed dowitcher (<u>Limnodromus griseus</u>)	M							x	x
Wilson's phalarope (<u>Steganopus tricolor</u>)	U							x	x
Ring-billed gull (<u>Larus delawarensis</u>)	MC					x			x
Bonaparte's gull (<u>Larus philadelphia</u>)	U							x	⊕
Common tern (<u>Sterna hirundo</u>)	R								x
Black tern (<u>Chidonias niger</u>)	C							x	x
Mourning dove (<u>Zenaidura macroura</u>)	U	x	x	x		x			

SPECIES	ABUNDANCE ¹	HABITAT TYPE ²							
		A	B	C	D	E	F	G	H
Great-horned owl (<u>Bubo virginianus</u>)	C	x	x	x					
Hawk owl (<u>Surnia ulula</u>)	U	x	x		x			x	
Long-eared owl (<u>Asio otus</u>)	R	x	x						
Short-eared owl (<u>Asio flammeus</u>)	R					x	x	x	
Nighthawk (<u>Chordeiles minor</u>)	MC	x	x	x	x	x			
Rufous hummingbird (<u>Selasphorus rufus</u>)	R		x	x	x	x	x		
Belted kingfisher (<u>Megaceryle alcyon</u>)	MC								x
Yellow-shafted flicker (<u>Colaptes auratus</u>)	C	x	⊕	x	⊕	x			
Red-shafted flicker (<u>Colaptes cafer</u>)	U	x	x	x	x	x			
Pileated woodpecker (<u>Dryocopus pileatus</u>)	U	x	x	x					
Yellow-bellied sapsucker (<u>Sphyrapicus varius</u>)	C		⊕	⊕					
Hairy woodpecker (<u>Dendrocopos villosus</u>)	U	x	⊕	x	x				
Downy woodpecker (<u>Dendrocopos pubescens</u>)	R		x	x	x				
Northern three-toed woodpecker (<u>Picoides tridactylus</u>)	R		x		x			x	
Eastern kingbird (<u>Tyrannus tyrannus</u>)	R				x	⊕			
Eastern phoebe (<u>Sayornis phoebe</u>)	MC								⊕
Say's phoebe (<u>Sayornis saya</u>)	VR					x			
Traill's flycatcher (<u>Empidonax trailli</u>)	U				⊕			⊕	
Least flycatcher (<u>Empidonax minimus</u>)	C		⊕	⊕	x				
Western wood pewee (<u>Contopus sordidulus</u>)	MC	x	⊕	⊕	x				
Olive-sided flycatcher (<u>Nuttallornis borealis</u>)	C	⊕	x	x	⊕			x	
Horned lark (<u>Eremophila alpestris</u>)	M					x	x		
Tree swallow (<u>Iridoprocne bicolor</u>)	C	x				x		x	⊕
Bank swallow (<u>Riparia riparia</u>)	R					x			⊕
Purple martin (<u>Progne subis</u>)	VR	x				x		x	x
Gray jay (<u>Perisoreus canadensis</u>)	C	⊕	x	x	⊕			x	
Blue jay (<u>Cyanocitta cristata</u>)	U	x		x					
Magpie (<u>Pica pica</u>)	MC			x	x	⊕			
Raven (<u>Corvus corax</u>)	R	⊕	x	x	⊕	x	x	x	x
Common crow (<u>Corvus brachyrhynchos</u>)	C	x	x	⊕	x	x	x	x	x



SPECIES	ABUNDANCE ¹	HABITAT TYPE ²							
		A	B	C	D	E	F	G	H
Clarke's nutcracker (<u>Nucifraga columbiana</u>)	MC	x		x					
Black-capped chickadee (<u>Parus atricapillus</u>)	MC		⊕	⊕	x				
Mountain chickadee (<u>Parus gambeli</u>)	R	x	x						
Boreal chickadee (<u>Parus hudsonicus</u>)	MC	⊕	x						
Red-breasted nuthatch (<u>Sitta canadensis</u>)	C	x	x						
Brown creeper (<u>Certhia familiaris</u>)	U	x	x	x					
Dipper (<u>Cinclus mexicanus</u>)	MC								x
House wren (<u>Troglodytes aedon</u>)	U				x				
American robin (<u>Turdus migratorius</u>)	C	⊕			⊕	x			
Barn swallow (<u>Hirundo rustica</u>)					⊕				
Cliff swallow (<u>Petrochelidon pyrrhonota</u>)					⊕				
Violet-green swallow (<u>Tachycineta thalassina</u>)					⊕				⊕
Varied thrush (<u>Ixoreus naevius</u>)	MC	x	x	x					
Hermit thrush (<u>Hylocichla guttata</u>)	U	x	x						
Swainson's thrush (<u>Hylocichla ustulata</u>)	MC	⊕	x	x	x				
Veery (<u>Hylocichla fuscescens</u>)	MC		x	x	x				
Mountain bluebird (<u>Sialia currucoides</u>)	C				⊕	x			
Townsend's solitaire (<u>Myadestes townsendi</u>)	U	x	x	x	x				
Golden-crowned kinglet (<u>Regulus satrapa</u>)	C	⊕	⊕						
Ruby-crowned kinglet (<u>Regulus calendula</u>)	MC	⊕	⊕					x	
Water pipit (<u>Anthus spinoletta</u>)	MC					x	x		
Cedar waxwing (<u>Bombycilla cedrorum</u>)	U	x	x	x	x			x	x
Red-eyed vireo (<u>Vireo olivaceus</u>)	U		⊕	⊕	x				
Warbling vireo (<u>Vireo gilvus</u>)	MC		⊕	⊕	x				
Black-and-white warbler (<u>Mniotilta varia</u>)	U			⊕					
Tennessee warbler (<u>Vermivora peregrina</u>)	MC	x	⊕	⊕	x			x	
Orange-crowned warbler (<u>Vermivora celata</u>)	R			⊕	x				
Yellow warbler (<u>Dendroica petechia</u>)	MC				⊕			x	



SPECIES	ABUNDANCE ¹	HABITAT TYPE ²							
		A	B	C	D	E	F	G	H
Magnolia warbler (<u>Dendroica magnolia</u>)	R	x	x	⊕	x				
Cape may warbler (<u>Dendroica tigrina</u>)	R	x	x						
Myrtle warbler (<u>Dendroica coronata</u>)	C	⊕	⊕	⊕					
Bay-breasted warbler (<u>Dendroica castanea</u>)	R	x	x		x				
Blackpoll warbler (<u>Dendroica straita</u>)	U	x			x				
Ovenbird (<u>Seiurus aurocapillus</u>)	C			x					
Northern waterthrush (<u>Seiurus noveboracensis</u>)	MC							x	x
Connecticut warbler (<u>Oporornis agilis</u>)	MC	⊕		x	x			⊕	
Mourning warbler (<u>Oporornis philadelphia</u>)	U				⊕			x	
MacGillivray's warbler (<u>Oporornis tolmiei</u>)	U				x			x	
Yellowthroat (<u>Geothlypis trichas</u>)	U				x			x	
Western meadowlark (<u>Sturnella neglecta</u>)	U					x			
Yellow-headed blackbird (<u>Xanthocephalus xanthocephalus</u>)	R							x	
Red-winged blackbird (<u>Agelaius phoeniceus</u>)	C					x		⊕	
Baltimore oriole (<u>Icterus galbula</u>)	R			x					
Brewer's blackbird (<u>Euphagus cyanocephalus</u>)	U				x	⊕			
Brown-headed cowbird (<u>Molothrus ater</u>)	MC					⊕			
Western tanager (<u>Piranga ludoviciana</u>)	U	x	⊕						
Rose-breasted grosbeak (<u>Pheucticus ludovicianus</u>)	R		x	⊕					
Pine grosbeak (<u>Pinicola enucleator</u>)	C	x	x						
Grey-crowned rosy finch (<u>Leucosticte tephrocotis</u>)	MC						x		
Common redpoll (<u>Acanthis flammea</u>)	C	x	x	x	x	x	x	x	
Pine siskin (<u>Spinus pinus</u>)	C	⊕	x		⊕				
White-winged crossbill (<u>Loxia leucoptera</u>)	U	x	x						
Savannah sparrow (<u>Passerculus sandwichensis</u>)	MC					x		x	



SPECIES	ABUNDANCE ¹	HABITAT TYPE ²							
		A	B	C	D	E	F	G	H
Vesper sparrow (<u>Pooecetes gramineus</u>)	U					x			
Slate-colored junco (<u>Junco hyemalis</u>)	C	⊕	x		⊕				
Oregon junco (<u>Junco oreganus</u>)	MC	x	x		x				
Tree sparrow (<u>Spizella arborea</u>)	M				x		x	x	
Chipping sparrow (<u>Spizella passerina</u>)	C			x	x				
Red crossbill (<u>Loxia curvirostra</u>)		⊕							
Rusty blackbird (<u>Euphagus carolinus</u>)								⊕	
Clay-colored sparrow (<u>Spizella pallida</u>)	MC				⊕			x	
Brewer's sparrow (<u>Spizella breweri</u>)	MC					x	x		
White-crowned sparrow (<u>Zonotrichia leucophrys</u>)	C				x				
Golden-crowned sparrow (<u>Zonotrichia atricapilla</u>)	R				x		x		
White-throated sparrow (<u>Zonotrichia albicollis</u>)	C	x	⊕		⊕				
Fox sparrow (<u>Passerella iliaca</u>)	R				x				
Lincoln's sparrow (<u>Melospiza lincolnii</u>)	U				x				
Swamp sparrow (<u>Melospiza georgiana</u>)	U				x			x	
Song sparrow (<u>Melospiza melodia</u>)	C				⊕	x	x	x	
*Common snipe (<u>Capella gallinago</u>)								⊕	
Winter wren (<u>Troglodytes troglodytes</u>)		⊕							
Wilson's warbler (<u>Wilsonia pusilla</u>)					x			⊕	
American redstart (<u>Setophaga ruticilla</u>)			x	⊕	x				
Evening grosbeak (<u>Hesperiphona vespertina</u>)		x	x		x				
Purple finch (<u>Carpodacus purpureus</u>)		x	x		x				

¹ABUNDANCE: - C = common, MC = moderately common, M = moderate,
U = uncommon, R = rare, VR = very rare.

²HABITAT TYPE: - A = coniferous forest, B = mixedwoods, C = deciduous forest, D = recent burns and cut over areas, second growth and brush, E = open fields and grasslands, F = tundra and barrens, G = marsh, muskeg, and bog, H = rivers and lakes.



- x Observed by Soper (1947, 1949)
- ⊕ Observed during 1973 field investigations

*The final six species are not reported by Soper, but their patterns of distribution and habitat preference suggest that they occur in the area.

APPENDIX II-5

FISH HABITAT AND POPULATIONS IN PROJECT AREA

FISH HABITAT AND POPULATIONS IN PROJECT AREA



SCHULCO

Major watershed Upper Big Smoky River

SUB WATERSHED	CODE	CLASS	FISH SPECIES ¹
Upper Big Smoky R.	P 7GA-1*	* / 10 (1+7) 4 DE (c)	WS, LNS, MW, UN.
Sheep Creek	P 7GA-2*	* / 6 (0+1) 3 2 T 3 BT	UN.
Muskeg River	P 7GA-3*	1.0 / 8 (2+2) 1 2 T 3 BT	DV, RB, AG, MW, EB.
Sulphur River	P 7GA-4*	* / 1 (0+1) 7 2 T 3 BT	UN.

Major watershed Lower Big Smoky River

Lower Big Smoky R.	7GB-1*	* / 6 (0+2) 4 (0+2)	AG, WE, DV, MW, NP, UN.
Lower Big Smoky R.	P 7GB-1(1) 7GB-2*	2 D 4 ED (c) 0.5 / 10 (1+0) 4 C (w)	
Cutbank R.	7GB-2*	* / 10 (0+7) 2 BE (c)	EB, DV, MW, AG, LNS, UN.
Kakwa R.	7GB-3*	* / 9 (0+7) 1 (0+2)	MW, AG, DV, RB, BB, UN.
Prairie Creek	7GB-4*	* / 10 (0+1) 2 TE (c)	DV, AG, UN.
Copton Creek	7GB-5*	* / 10 (0+4) 2 TE (c)	

P part of watershed out of study area



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Major watershed Upper Wapiti						
SUB WATERSHED	CODE	CLASS			FISH SPECIES ¹	
Upper Wapiti	P	1.0/	3	(0+4)	7	(3+2)
	7GC-1*		3	D	4	DE (c)
Pinto Creek	7GC-2*	*/	10	(0+2)		(c)
			2	E		(c)
Nose Creek	7GC-3*	*/	10	(0+8)		(c)
			3	DR		(c)
Narraway R.	P	*/	9	(0+3)	1	(0+1)
	7GC-4*		2	T	3	ET (c)



Major watershed		Lower Wapiti		FISH SPECIES ¹
SUB WATERSHED	CODE	CLASS		
Lower Wapiti	P	0.5/ 10 (0+2)		
	7GE-1	4 DE (w)		
Upper Big Mtn. Creek	P	* / 10 (0+6)		LNS, LSS, WS, NW.
	7GE-3	4 DR (c)		
Lower Big Mtn. Creek	P	* / 10 (0+1)		LNS, LSS, WS.
	7GE-3	4 DE (w)		
Major watershed Simonette				
Upper Simonette	7GF-1*	* / 8 (0+2)	2 (1+0)	AG, DV, MU, LNS, UN.
Middle Simonette	7GF-1*	2 T	4 D (c)	
Lower Simonette	P	1.0/ 1 (0+1)	1 (0+1)	AG, DV, MW, LNS, LSS,
	7GF-1*	2 E	3 ET 4 D (c)	WS, NP, WE.
Economy Creek	P	1.0/ 1 (0+1)	9 (4+0)	
	7GF-3(1)	3 D	4 D (c)	
Latarnell River	7GF-4*	* / 8 (0+3)	2 (1+0)	AG, UN.
		3 ET 4 D		
Deep Valley Creek	7GF-5*	* / 10 (0+1)		AG, UN.
		2 T		
Deep Valley Creek	7GF-5*	1.0/ 3 (0+2)	7 (1+0)	AG, UN.
		2 E 4 D		



Major watershed Little Smoky River				
SUB WATERSHED	CODE	CLASS	FISH SPECIES ¹	
Upper Little Smoky	7GG-1*	* / 7 (0+1) 3 (0+3)	AG, DV, BB, UN.	
		2 T 3 D		
Upper Little Smoky	7GG-1*	* / 10 (0+1)	AG, DV, UN.	
		2 T		
Lower and Middle Little Smoky	P	1.0 / 5 (1+0) 5 (1+0)	AG, DV, WS, UE, NP.	
Asplund Creek	7GG-1 1	3 FD 4 D	UN.	
	P	* / 10 (0+1)		
Waskahigan River	7GG-3*	3 F	AG, UN.	
	P	0.5 / 4 (0+1) 6 (1+0)	AG, UN.	
	7GG-4*	3 DE 4 D		
Tony Creek	7GG-7*	* / 10 (0+1)	AG, UN.	
		2 E		
Major watershed Upper Athabasca				
Solomon Creek	7AA-1*	* / 10 (0+1)	RB, UN.	
		3 T		
Bruce Lake	7AA-1 1	5 / 4 (0+1) 3 (2+2) 3 (3+0)	RB, UN.	
		2 T 3 SP 4 D (c)		



Major watershed Berland River

SUB WATERSHED	CODE	CLASS	FISH SPECIES ¹
Upper Berland	P		
	7AC-1*	* / 5 (0+1) 3 (0+7) 2 (1+0)	AG, MW, DV, RB, UN.
Middle Berland	7AC-1*	2 T 3 BE 4 D (c)	AG, MW, NP, RB, DV,
		* / 10 (0+1) 3 At (c)	UN.
Middle and Lower Berland	7AC-1*	* / 10 (0+4) 2 D (c)	AG, MW, NP, RB, DV.
Upper Wildhay R.	P	* / 10 (1+7) 2 B (c)	DV, RB, EB, MU, UN.
	7AC-2*	2 B 1 (0+1)	AG, DV, RB, MW, EB.
Middle and Lower Wildhay River	7AC-2*	1.0 / 9 (0+3) 3 D (c)	NP, WE, WS, LW, DV.
Jarvis Creek	7AC-3 (2)	1.5 / 3 (1+3) 7 (4+1) 3 SD (c)	CT.
Upper Pinto Creek	7AC-4*	* / 4 (0+2) 6 (0+2) 3 B (c)	RB, AG, UN.
Lower Pinto Creek	7AC-4*	0.5 / 10 (0+1) * (0+2) 3 D (c)	AG, RB, MW, DV

Major watershed Middle Athabasca

Athabasca	7AD-1 1	1.0 / * (0+1) 4 (0+3) 3 (0+6) 3 (7+0)	RB, WP, GE, MW, DV,
		1 2 D 3 DE 4 D (c)	EB, BT, UN.
Oldman Creek	7AD-2*	0.5 / 8 (0+1) 2 (0+2) 3 DB (c)	AG, MW, RB.



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APP-II-5/6

Major watershed Lower Athabasca

SUB WATERSHED	CODE	CLASS.	FISH SPECIES ¹
Windfall Creek	P 7AE-4*	* / 10 (0+1) 2 B (c)	AG, UN.
Pine Creek	P 7AE-5*	* / 10 (0+1) 2 D (c)	RB, MW, AG.
Beaver Creek	P 7AE-1		UN.

Major watershed McLeod River

Upper McLeod	7AF-1A*	1.5 / 7 (0+7)	1 (1+6)	RB, MW, DV, LNS, EB,
Upper McLeod	7AF-1*	0.5 / 6 (0+1)	3 DS (c)	BB, NP, CT?
Lower McLeod	7AF-1B1	1.5 / 3 (1+2)	3 A (c)	UN.
Frith River	7AF-2*	0.5 / 6 (0+3)	2 (1+2) 3 SD 5 (1+1)	NP, RB, MW, AG.
Embarass River	7AF-3*	1.0 / 6 (0+4)	4 D (c) 3 DC (c)	RB, UN. Poor Habitat.
		2 D 3 CD (c)		RB, NP, EB, MW, AG,
				LNS, DV, BT.



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Major watershed Pembina River				
SUB WATERSHED	CODE	CLASS	FISH SPECIES ¹	
Upper Pembina	7BA-1(1)	* / 5 (0+3) 5 (1+2)	UN	
		2 D 3 D		
Upper Pembina	P	1.0 / 8 (0+2) 2 (1+1)	WE, NP, MU, AG, EB,	
	7BA(-1)	2 R 3 SD (c)	RB, DV.	

Gathered from A.R.D.A. Water Capability Classification for Sport Fish Maps

1 Key to Species

UN	Unknown	BT	Brown trout
WS	White sucker	CT	Cutthroat trout
LNS	Longnose sucker	AG	Arctic grayling
LSS	Large scale sucker	WE	Walleye
MW	Mountain whitefish	GE	Goldeye
DV	Dolly varden trout	NP	Northern pike
RB	Rainbow trout	BB	Burbot
EB	Eastern brook trout	LW	Lake whitefish

APPENDIX II-6

RELATIVE FISHERY CAPABILITIES OF
SOME STREAMS IN THE PROJECT AREA



APPENDIX II-6

Relative fishery capabilities of some streams in the timber harvest study area, based on sampling and physical habitat suitability, and subsequent evaluation of stream crossings; June, 1973.

SITE #	STREAM	TRIB. TO	DATE (JUNE)	SAMPLE METHOD	SPECIES COLLECTED NO.	H ₂ O (°F) TEMP.	HABITAT SUITABILITY		ROAD CROSSING EVALUATION
							TROUT-CHAR GRAYLING	WARM-WATER GAMEFISH	
1	Lick Ck.	Torrens R.	19	Obs.	-	44	St.	Un.	Ex. (Bridge)
2	Unnamed	Torrens R.	19	Obs.	-	-	Ma.	Un.	Poor
3	Unnamed	Torrens R.	19	Obs.	-	45	Ma.	Un.	Good
4	Stetson Ck.	Torrens R.	19	Sh; Obs.	RB 3 MW 2 SC 1	53	St.	Un.	Poor
5	Two Lakes Outlet	Stetson Ck. (Torrens R.)	21	Ef; Obs.	RB 20	53	St.	Un.	Poor
6	Unnamed	Naraway R.	19	Obs.	-	45	Ma.	Un.	Poor
7	Hammer Ck.	Nose Ck.	21	SN; Obs.	CF	58	Un.	Ma.	Ex. (Bridge)
7 (a)	Nose Ck.	Wapiti R.	19	Obs.	-	57	Un.	Ma.	Ex. (Bridge)
8	Wanyandie Ck.	Nose Ck.	19	SN; Obs.	-	-	Un.	Ma.	Poor
9	Pinto Ck.	Wapiti R.	19	Obs.	-	58	Un.	Ma.	Ex.
10	Iroquois Ck.	Wapiti R.	19	Obs.	-	58	Un.	Ma.	Ex. (Bridge)
11	West Iroquois Ck.	Iroquois Ck.	19	Obs.	-	-	Un.	Un.	Poor
12	Bald Mtn. Ck.	Big Mtn. Ck.	20	EF; SN. Obs.	AG 2 MW 1 Pike 8 CF	59	Un.	St.	Ex. (Bridge)
13	Bridge Ck.	Big Mtn. Ck.	20	Obs.	-	-	Un.	Un.	Pair
14	Bald Mtn. Ck.	Big Mtn. Ck.	21	EF; SN; PC; Obs.	CF	53	Un.	Ma.	Ex.
15	Big Mtn. Ck.	Wapiti R.	20	Obs.	-	56	Un.	Ma.	Ex. (Bridge)
15 (a)	Big Mtn. Ck.	Wapiti R.	21	Obs.	-	-	Un.	Ma.	Ex.
16	Economy Ck.	Simonette R.	22	Obs.	-	65	Un.	St.	Un.



SITE	STREAM	TRIB. TO	DATE (JUNE)	SAMPLE METHOD	SPECIES COLLECTED NO.	H ₂ O (°F) TEMP.	HABITAT SUITABILITY			ROAD CROSSING EVALUATION
							TROUT-CHAR	GRAYLING	WARM-WATER GAMEFISH	
17	Unnamed	Smoky R.	21	Obs.	-	-	Un.	Un.	Un.	Fair
18	Unnamed	Smoky R.	21	Obs.	-	-	Un.	Ma.	Un.	Poor
19	Unnamed	Smoky R.	21	Obs.	-	-	Un.	Un.	Un.	Poor
20	Zero Ck.	Smoky R.	22	SN; PC; Obs.	CF	58	Un.	Ma.	Un.	Poor
21	Unnamed	Latornell (Simonette R.)	22	Obs.	-	67	Un.	Un.	Un.	Good
22	Unnamed (2)	Gold Ck. (Big Mtn. Ck.)	21	Obs.	-	-	Un.	Un.	Un.	Fair
23	Unnamed	Cutbank R.	21	Obs.	-	49	Un.	Ma.	Un.	Poor
24	Unnamed	Cutbank R.	21	Obs.	-	-	Un.	Un.	Un.	Poor
25	Patterson Ck.	Smoky R.	20	SN; Obs.	CF	56	Un.	St.	Un.	Poor
26	Cutbank R.	Smoky R.	21	Obs.	-	60	Un.	Ma.	St.	Fair (Bridge)
27	Elk Ck.	Cutbank R.	21	Obs.	-	54	Un.	St.	Un.	Poor
28	Cutbank R.	Smoky R.	21	Obs.	-	-	Un.	Ma.	St.	Ex. (Bridge)
29	Unnamed	Cutbank R.	21	Obs.	-	-	Un.	Un.	Un.	Good
30	Smuland Ck.	Latornell R.	20	EF; SN; PC; Obs.	AG	58	Un.	St.	Un.	Poor
31	Carrington Ck.	Latornell R.	20	SN.	CF	62	Un.	Ma.	Un.	Poor
32	Unnamed	Cutbank R.	21	Obs.	-	68	Un.	Un.	Un.	Poor
33	Unnamed	Cutbank R.	21	Obs.	-	-	Un.	Un.	Un.	Poor
34	Musreau Lk Outlet	Kakwa R.	21	Obs.	-	55	Un.	St.	Un.	Poor (Bridge)
35	Unnamed	Musreau Lk. Outlet	21	Obs.	-	45	Un.	Ma.	Un.	Poor
36	Kar Ck.	Latornell R.	20	SN; Obs.	CF	54	Un.	Ma.	Un.	Poor



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SITE #	STREAM	TRIB. TO	DATE (JUNE)	SAMPLE METHOD	SPECIES COLLECTED NO.	H ₂ O (°F) TEMP.	HABITAT SUITABILITY			ROAD CROSSING EVALUATION
							TROUT-CHAR	GRAYLING	WARM-WATER GAMEFISH	
37	Unnamed	Musreau Lk. Outlet	21	Obs.	-	-	Un.	Ma.	Un.	Poor
38	Unnamed	Kakwa R.	21	Obs.	-	-	Un.	Ma.	Un.	Poor
41	Frying Pan Ck.	Latarnell R.	22	EF; Obs.	AG 1 SC 1	61	Ma.	St.	Un.	Good (Bridge)
42	Unnamed	Smoky R.	20	Obs.	-	-	Un.	Un.	Un.	Poor
43	Unnamed	Smoky R.	20	Obs.	-	-	Un.	Un.	Un.	Poor
44	Bickle Ck.	Smoky R.	20	PC; Obs.	-	49	St.	St.	Un.	Poor
45	Unnamed	Bolton Ck.	14	Obs.	-	-	Ma.	Ma.	Un.	Poor
46	Washy Ck.	Susa Ck.	23	Obs.	-	-	Un.	Un.	Un.	Poor
47	Susa Ck.	Muskeg R.	23	EF; Obs.	Burb Suck 4	60	Un.	Un.	Un.	Poor
48	Mason Ck.	Muskeg R.	23	EF; Ang, Obs.	DV 2	56	St.	Un.	Un.	Ex. (Bridge)
49	Lone Teepee Ck.	Muskeg R.	22	Obs.	-	54	St.	Ma.	Un.	Ex. (Bridge)
50	Pierre Grey Lks. Outlet (South)	Muskeg R.	23	EF; Obs.	RB Many	64	St.	Un.	Un.	Ex.
51	Burleigh Ck.	Muskeg R.	22	Obs.	-	-	St.	Un.	Un.	Good
52	Lone Teepee Ck.	Muskeg R.	25	EF; Obs.	-	54	St.	Un.	Un.	Poor
53	Unnamed	Lone Teepee Ck.	22	Obs.	-	-	St.	Un.	Un.	Poor
54	Shand Ck.	Lone Teepee Ck.	22	Obs.	-	50	St.	Un.	Un.	Poor
55	Unnamed	Hendrickson Ck.	22	EF; Obs.	DV 1	-	St.	Un.	Un.	Poor
56	Hendrickson Ck.	Berland R.	22	Obs.	-	54	St.	Un.	Un.	Good
57	Cabin Ck.	Berland R.	22	Ang, Obs.	-	-	St.	Un.	Un.	Ex. (Bridge)



SITE #	STREAM	TRIB. TO	DATE (JUNE)	SAMPLE METHOD	SPECIES COLLECTED NO.	H ₂ O (°F) TEMP.	HABITAT SUITABILITY			ROAD CROSSING EVALUATION
							GRAYLING	WARM-WATER GAMEFISH	TROUT-CHAR	
58	Berland R.	Athabasca R.	22	Obs.	-	-	St.	Un.	Ex. (Bridge)	
59	Fox Ck.	Berland R.	25	EF; Obs.	MW 3	54	St.	Un.	Ex.	
60	Little Berland R.	Berland R.	25	SN; Obs.	DV 1	-	St.	Un.	Ex. (Bridge)	
61	Hightower Ck.	Wildhay R.	25	EF; Obs.	MW 5	52	St.	Un.	Poor	
62	Pinto	Wildhay R.	25	EF; Obs.	RB 1	-	St.	Un.	Poor (Bridge)	
64	Moberly Ck.	Wildhay R.	13	Ang; Obs.	-	-	St.	Un.	Ex. (Bridge)	
65	N. Wildhay R.	Berland R.	23	Obs.	-	-	St.	Un.	Ex. (Bridge)	
66	Collie Ck.	Wildhay R.	23	Obs.	-	-	St.	Un.	Ex. (Bridge)	
67	Doctor Ck.	Wildhay R.	23	Obs.	-	-	St.	Un.	Good	
68	Wildhay R.	Berland R.	23	Obs.	-	-	St.	Un.	Ex. (Bridge)	
69	Twelve Mile Ck.	Wildhay R.	22	Obs.	-	49	Ma.	Un.	Fair	
70	Winter Ck.	Jarvis Ck. (Wildhay R.)	22	Obs.	-	-	Ma.	Un.	Ex. (Bridge)	
71	Unnamed	Jarvis Ck.	22	Obs.	-	64	Ma.	Un.	Ex.	
71	Unnamed	Jarvis Ck.	22	Obs.	-	-	Ma.	Un.	Fair	
71	Unnamed	Jarvis Ck.	22	Obs.	-	57	Ma.	Un.	Good	
72	Barbara Ck.	Wildhay R.	13	Obs.	-	44	Ma.	Un.	Ex. (Bridge)	
73	Jarvis Ck.	Wildhay R.	13	Ang; Obs.	RB 2	54	St.	Un.	Ex. (Bridge)	
74	Oldman Ck.	Athabasca R.	11	Obs.	MW -	-	Un.	Un.	Good	
75	Oldman Ck.	Athabasca R.	11	Ang; Obs.	-	-	St.	Un.	Ex. (Bridge)	
76	Unnamed	Oldman Ck.	11	Obs.	-	-	Un.	Un.	Good	





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SITE #	STREAM	TRIB. TO	DATE (JUNE)	SAMPLE METHOD	SPECIES COLLECTED	NO.	H ₂ O (°F) TEMP.	HABITAT SUITABILITY			ROAD CROSSING EVALUATION
								GRAYLING	WARM-WATER GAMEFISH		
77	Fish Ck.	Athabasca R.	23	Obs.	-	-	51	St.	Un.	Un.	Fair
78	Centre Ck.	Athabasca R.	23	Obs.	-	-	49	St.	Un.	Un.	Poor
79	Teacamp Ck.	Athabasca R.	23	Obs.	-	-	47	Ma.	Un.	Un.	Poor
80	Marl Ck.	Athabasca R.	23	Obs.	-	-	-	Ma.	Un.	Un.	Good
81	Canyon Ck.	Athabasca R.	23	Obs.	-	-	50	St.	Un.	Un.	Ex.
82	Unnamed	Athabasca R.	23	Obs.	-	-	53	Ma.	Un.	Un.	Poor
83	Baseline Ck.	Athabasca R.	26	PC; Obs.	EB	2	49	St.	Un.	Un.	Poor
					RB	1					
84	Gorge Ck.	Athabasca R.	26	SN; Obs.	EB	1	50	St.	Un.	Un.	Poor
85	Plante Ck.	Athabasca R.	11	SN; Ang;	RB	4	-	St.	Un.	Un.	Fair
				Obs.	DV						
86	Emerson Lks. Outlets.	Athabasca R.	23	Obs.	-	-	54	St.	Un.	Un.	Good
87	Nosehill Ck.	Athabasca R.	23	Obs.	-	-	64	St.	St.	Un.	No Crossing
88	Unnamed	Pine Ck.	23	Obs.	-	-	50	St.	St.	Un.	Poor
89	Unnamed	Edson R.	23	Obs.	-	-	49	St.	St.	Un.	Poor
90	Unnamed	Edson R.	23	Obs.	-	-	52	St.	St.	Un.	Poor
91	Unnamed	Edson R.	23	Obs.	-	-	-	St.	St.	Un.	Poor
92	Unnamed	Edson R.	23	Obs.	-	-	52	St.	St.	Un.	Poor
93	Unnamed	Obed Lk.	6	Obs.	RB	-	47	St.	Un.	Un.	Poor
					CF	-					
94	Happy Ck.	Athabasca R.	24	Obs.	-	-	-	St.	Un.	Un.	Poor
95	Cold Ck.	Maskuta Ck.	24	SN; Obs.	EB	3	-	St.	Un.	Un.	Poor
96	Maskuta Ck.	Athabasca R.	11	Obs.	-	-	-	Ma.	Un.	Un.	Ex. (Bridge)



SITE #	STREAM	TRIB. TO	DATE (JUNE)	SAMPLE METHOD	SPECIES COLLECTED	NO.	H ₂ O (°F) TEMP.	HABITAT SUITABILITY			ROAD CROSSING EVALUATION
								TROUT-CHAR	GRAYLING	WARM-WATER GAMEFISH	
97	Wigwam Ck.	Gregg Ck.	24	Obs.	-	-	-	St.	Un.	Un.	Poor
98	Teepee Ck.	Gregg Ck.	24	Obs.	-	-	-	Ma.	Un.	Un.	Poor
99	Unnamed	Gregg Ck.	24	Obs.	-	-	-	Ma.	Un.	Un.	Poor
100	Warden Ck.	McLeod R.	7	SN; Obs.	RB	3	49	St.	Un.	Un.	Ex. (Bridge)
					MW	5					
					DV	1					
					SC	-					
101	Gregg R.	McLeod R.	24	Obs.	-	-	-	St.	Un.	Un.	Ex. (Bridge)
102	Drinnan Ck.	Gregg R.	7	Obs.	-	-	-	St.	Un.	Un.	No Crossing
103	Gregg R.	McLeod R.	24	Obs.	-	-	-	St.	Un.	Un.	Poor
104	Berry's Ck.	Gregg R.	24	Obs.	-	-	-	St.	Un.	Un.	Poor
105	Gregg R.	McLeod R.	24	Obs.	-	-	-	St.	Un.	Un.	Poor
106	Luscar Ck.	McLeod R.	24	Obs.	-	-	-	Ma.	Un.	Un.	Ex. (Bridge)
107	Watson Ck.	McLeod R.	24	Obs.	-	-	-	St.	Un.	Un.	Poor
108	Felton Ck.	McLeod R.	6	EF; SN; Obs.	RB	-	-	St.	Un.	Un.	Ex. (Bridge)
					DV	-	-	St.	Un.	Un.	Ex. (Bridge)
					SC	-	-				
109	White Ck.	McLeod R.	6	Obs.	-	-	-				
110	McNeill Ck.	Embarras R.	6	Obs.	-	-	41	Ma.	Un.	Un.	Fair
111	Lambert Ck.	Embarras R.	6	Obs.	-	-	-	St.	St.	Un.	Poor
112	McLeod R.	Athabasca R.	6	Obs.	RB	-	54	St.	Un.	Un.	Ex. (Bridge)
113	Erith R.	McLeod R.	8	Obs.	-	-	-	St.	Ma.	Un.	Ex. (Bridge)
					-	-	55	Un.	Ma.	St.	Bridge Wash- out
114	Unnamed	Erith R.	8	Obs.	-	-	52	Un.	Un.	Un.	Fair





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SITE #	STREAM	TRIB. TO	DATE (JUNE)	SAMPLE METHOD	SPECIES COLLECTED NO.	H ₂ O (°F) TEMP.	HABITAT SUITABILITY		
							TROUT-CHAR	GRAYLING	WARM-WATER CROSSING GAMEFISH EVALUATION
115	Unnamed	Erith R.	8	Obs.	CF	Abund.	Ma.	Un.	Ex. (Bridge)
116	Erith R.	McLeod R.	8	Obs.	-	56	Ma.	St.	Ex. (Bridge)
40	Unnamed	Latornell R.	22	Obs.	-	-	Un.	Un.	Poor
117	Caronte Ck.	Susa Ck. (Muskeg R.)	23	Obs.	-	-	Un.	Un.	Poor
118	Mitayimin Ck.	Susa Ck.	23	Obs.	-	50	Un.	Un.	Poor
50 (b)	Pierre Grey Lk. Outlet (North)	Muskeg R.	23	Obs.	-	54	Ma.	Un.	Poor

LEGEND

Sample Method		Species Collected		Habitat Suitability	
(Obs.)	Observation	(RB)	Rainbow trout <u>Salmo gairdneri</u> (Richardson)	Trout Char - RB, EB, DV, MW	
(SH)	Seining	(DV)	Dolly varden <u>Salvelinus malma</u> (Walbaum)	Grayling - AG, MW	
(EF)	Electrofishing	(EB)	Brook trout <u>Salvelinus fontinalis</u> (Mitchill)	Warm-water Gamefish - PIKE	
(PC)	Prima Cord Explosives	(AG)	Arctic grayling <u>Thymallus arcticus</u> (Pallas)	Un. - unsuitable	
(ANG)	Angling	(MN)	Mountain whitefish <u>Prosopium williamsi</u> (Girard)	Ma. - marginal	
		(PIKE)	Northern pike <u>Esox lucius</u> (Linnaeus)	St. - suitable	
		(BURB)	Burbot <u>Lota lota</u> (Linnaeus)		
		(SUCK)	Suckers <u>Catostomus</u> sp.		
		(SC)	Sculpins <u>Cottus</u> sp.		
		(CF)	Coarse fish (includes suckers, forage fish)		



APPENDIX II-7

SUMMARY OF STREAM CROSSING OBSERVATIONS
IN TIMBER HARVEST STUDY AREA,
JUNE-AUGUST, 1973

APPENDIX II-7

Summary of stream crossing observations in timber harvest study area, June - August, 1973

summary of stream crossing observations and culvert

SITE #	STREAM	TRIB. TO	DATE	CROSSING STRUCTURE		PASSABILITY RATING	ENTRANCE		CULVERT PROBLEMS			EROSION PROBLEMS	
				BRIDGE	CULVERT		OUTFALL	TURBULENCE	EXIT	VELOCITY	OTHERS	FILL	DITCH
1	Lick Ck.	Torrrens R.	June 19	+		Ex.	N/A	N/A	N/A	N/A			
2	Unnamed	Torrrens R.	19		+	Imp.							
3	Unnamed	Torrrens R.	19		Log Culvert	Good							
4	Stetson Ck.*	Torrrens R.	20		Large CMP	Poor	*	*		*		*	
5	Two Lakes Outlet*	(Torrrens R.) Stetson Ck.	20		3' CMP	Imp.	1'*	+					
6	Unnamed*	Narraway R.	20		+	Imp.	4'					*	
7	Hammer Ck.	Nose Ck.	19	+		Ex.	N/A	N/A	N/A	N/A	N/A		
7	Nose Ck.	Wapiti R.	19	+		Ex.	N/A	N/A	N/A	N/A	N/A		
8	Wanyandie Ck.	Nose Ck.	19		+	Imp.	2'					+	
9	Pinto Ck.	Wapiti R.	20	+		Ex.	N/A	N/A	N/A	N/A	N/A		
10	Iroquois Ck.	Wapiti R.	19	+		Ex.	N/A	N/A	N/A	N/A	N/A		
11	West Iroquois Ck.	Iroquois Ck.	19		+	Imp.	4'						
12	Bald Mtn. Ck.	Big Mtn. Ck.	20	+		Ex.	N/A	N/A	N/A	N/A	N/A		
13	Bridge Ck.	Big Mtn Ck.	20		+	Fair			+				
14	Bald Mtn. Ck.	Big Mtn. Ck.	21		Large CMP	Ex.							
15	Big Mtn. Ck.	Wapiti R.	20	+		Ex.	N/A	N/A	N/A	N/A	N/A		
15 (a)	Big Mtn. Ck.	Wapiti R.	21			Ex.							
16	Economy Ck.	Simonette R.	22		29' CMP	Ex.							
17	Unnamed	Smoky R.	21		5' CMP	Ex.	2½'					*	
18	Unnamed*	Smoky R.	21		24" CMP	Imp.	Dry-4'					*	
19	Unnamed	Smoky R.	21		Dual 5' CMP	Imp.	2½'					+	
20	Zero Ck.*	Smoky R.	20		Dual CMP	Imp.	3'-1'*	+	+		+		
21	Unnamed	Latornell R. (Simonette R.)	22		Dual 36" CMP	Good	Dry-0						
22	Unnamed (2)	Gold Ck. (Big Mtn. Ck.) (Wapiti R.)	21		+	Imp.	+						



SCHULCO



SC-HALCO

SITE #	STREAM	TRIB. TO	DATE	CROSSING STRUCTURE		PASSABILITY RATING	CULVERT PROBLEMS				EROSION PROBLEMS		
				BRIDGE	CULVERT		ENTRANCE		EXIT	VELOCITY	OTHERS	FILL DITCH	
							OUTFALL	TURBULENCE					
23	Unnamed*	Cutbank R.	June 21		36" CMP	Imp.	3'				+	*	*
24	Unnamed*	Cutbank R.	21		Logs fill	Imp.							*
25	Patterson Ck.*	Smoky R.	20		Dual 48" CMP	Imp.	Dry-1'*	+		*			*
26	Cutbank R.*	Smoky R.	21	+		Ex.	N/A	N/A	N/A	N/A	N/A	+	*
27	Elk Ck.*	Cutbank R.	21		36" CMP	Fair							*
28	Cutbank R.	Smoky R.	21	+		Ex.	N/A	N/A	N/A	N/A	N/A		
29	Unnamed	Cutbank R.	21		+	Ex.	2'						
30	Smuland Ck.*	Latornell R. (Simonette R.)	20		5' CMP	Imp	1'*				*	*	*
31	Carrington Ck.	Latornell R. (Simonette R.)	20		4' CMP	Imp.	5'				+		
32	Unnamed*	Cutbank R.	21		+	Imp.	10'		*		*	*	*
33	Unnamed	Cutbank R.	21		5' CMP	Imp.	1½'					+	+
34	Musreau Lk. Outlet*	Kakwa R.	21	+		Ex.	N/A	N/A	N/A	N/A	N/A		*
35	Unnamed*	Musreau Lk.	21		Dual 24" CMP	Imp.	Dry-4'						
36	Kar Ck.*	Latornell R.	20		8' CMP	Imp.	5'*	*	+	*	+	*	*
37	Unnamed*	Musreau Ck. Outlet	21		15" - 24" CMP	Imp.	5'-Dry				+	+	*
38	Unnamed*	Kakwa R.	21		Washout	Imp.					*	*	*
40	Unnamed	Latornell R.	22		2' CMP	Imp.	8'				+	+	
41	Frying Pan Ck.	Latornell R. (Simonette R.)	22	+		Ex.	N/A	N/A	N/A	N/A	N/A		+
42	Unnamed*	Smoky R.	20		5' CMP	Imp.	6'					*	*
43	Unnamed	Smoky R.	20		3' CMP	Imp.	3'					*	*
44	Bickle Ck.*	Smoky R.	20		4' CMP	Imp.	7'*					*	*
45	Unnamed	Bolton Ck. (Smoky R.)	14		+	Fair						+	+





SCHULCO

SITE #	STREAM	TRIB. TO	DATE	CROSSING STRUCTURE		PASSABILITY RATING	CULVERT PROBLEMS				EROSION PROBLEMS	
				BRIDGE	CULVERT		ENTRANCE		EXIT	VELOCITY	OTHERS	FILL DITCH
							OUTFALL	TURBULENCE				
46	Washy Ck.	Susa Ck.	23		3' CMP	Imp.	2'					+
47	Susa Ck.	Muskeg R.	23		10' CMP	Imp.	1'					+
48	Mason Ck.	Torrens R.	23	+		Ex.						
49	Lone Teepee Ck	Muskeg R. (Smoky R.)	22	+		Ex.	N/A	N/A	N/A	N/A	N/A	
50(a)	Pierre Grey Lk Outlet	Muskeg R.	23		3' CMP	Ex.						
51	Burleigh Ck	Lone Teepee Ck (Muskeg R.)	22		+	Ex.						
52	Lone Teepee Ck**	Muskeg R.	22		8' CMP	Imp.	1 1/2'*				+	+
53	Unnamed	Lone Teepee Ck. (Muskeg R.)	22		+	Imp.	4'				+	+
54	Shand Ck	Lone Teepee Ck. (Muskeg R.)			5' CMP	Imp.	6"				+	+
55	Unnamed	Hendrickson Ck	22		+	Imp.	+	+			+	+
56	Hendrickson Ck	Berland R.	22		Bual 5' CMP	Good	Dry-0				+	+
57	Cabin Ck.	Berland R.	22	+		Ex.	N/A	N/A	N/A	N/A	N/A	
58	Berland R.	Athabasca R.	22	+		Ex.	N/A	N/A	N/A	N/A	N/A	
59	Fox Ck.	Little Berland R.	22		12' CMP	Ex.						
60	Little Berland R.	Berland R.	22	+		Ex.	N/A	N/A	N/A	N/A	N/A	
61	Hightower Ck.*	Wildhay R.	22		7' CMP	Imp.	3 1/2'	+			+	+
62	Fred Ck.	Pinto Ck. (Wildhay R.)	25	+		Ex.					+	+
64	Moberley Ck.	Wildhay R.	13	+		Ex.	N/A	N/A	N/A	N/A	N/A	
65	North Fork Wildhay R.	Berland R.	23	+		Ex.	N/A	N/A	N/A	N/A	N/A	
66	Collie Ck	Wildhay R.	23	+		Ex.	N/A	N/A	N/A	N/A	N/A	
67	Doctor Ck	Wildhay R.	23		Triple	Good	Dry-dry-0					
68	Wildhay R.	Berland R.	22	+		Ex.	N/A	N/A	N/A	N/A	N/A	
69	Twelve Mile Ck**	Wildhay R.	22		Duel 8'-3'	Imp.						
70	Winter Ck.	Jarvis Ck. (Wildhay R.)	22	+		Ex.	Dry-1 1/2'*					
71	Unnamed	Jarvis Ck.	22		Duel 5' CMP	Ex.						



SCHULCO

SITE #	STREAM	TRIB. TO	DATE	CROSSING STRUCTURE		PASSABILITY RATING	CULVERT PROBLEMS			EROSION PROBLEMS		
				BRIDGE	CULVERT		ENTRANCE	TURBULENCE	EXIT	VELOCITY	OTHERS	FILL DITCH
			June				OUTFALL					
71	Unnamed	Jarvis Ck.	22		Dual 4' CMP	Imp.	Dry-1½'					
71	Unnamed	Jarvis Ck.	22		10' CMP	Good						
72	Barbara Ck.	Wildhay R.	13	+		Ex.	N/A	N/A	N/A	N/A	N/A	
73	Jarvis Ck.	Wildhay R.	13	+		Ex.	N/A	N/A	N/A	N/A	N/A	
74	Old Man Ck.	Athabasca R.	11		3' CMP	Good						
75	Old Man Ck.	Athabasca R.	11	+		Ex.	N/A	N/A	N/A	N/A	N/A	
77	Fish Ck	Athabasca R.	23		Dual 4'-5' PA	Fair	6"					
78	Centre Ck.*	Athabasca R.	23		7' CMP	Imp.	1 1/2'*					
79	Teacamp Ck.*	Athabasca R.	23		36" CMP	Imp.	8"*					
80	Marl Ck.	Athabasca R.	23		+	Good						
81	Canyon Ck.	Athabasca R.	23		5' x 7' PA	Ex.				+		
82	Unnamed	Athabasca R.	23		24" CMP	Poor	6"			+		
83	Baseline Ck.*	Athabasca R.	23		9' CMP	Imp.	5'*					
84	Gorge Ck.*	Athabasca R.	23		5' CMP	Imp.	2 1/2'*					
85	Plante Ck.*	Athabasca R.	23			Ex.	N/A	N/A	N/A	N/A	N/A	*
86	Emerson Lks Outlet	Athabasca R.	23	+	14' CMP	Good						*
88	Unnamed*	Pine Ck.	23		4' CMP	Poor	6"			*		
89	Unnamed*	Edson R. (McLeod R.)	23		48" CMP	Imp.	1'				*	
90	Unnamed	Edson R.	23		7' CMP	Fair	Slight	+				
91	Unnamed*	Edson R.	23		9' CMP	Good					*	
92	Unnamed	Edson	23		Dual 5'-3' CMP	Fair	0-Dry			+	+	
94	Happy Ck.*	Athabasca R.	24		5' CMP	Imp.	12"*	*		*	*	
95	Cold Ck.*	Maskuta Ck. (Athabasca R.)	24		12' CMP	Imp.	3'*	*				
96	Maskuta Ck.	Athabasca R.	11	+		Ex.	N/A	N/A	N/A	N/A	N/A	*
97	Wigwam Ck.*	Gregg R. (McLeod R.)	24		9' CMP	Poor	2 1/2'*	+				*
98	Teepee Ck.*	Gregg R.	24		6' CMP	Poor	6"*				*	*
99	Unnamed*	Gregg R.	24		5' CMP	Imp	1 1/2'				+	*



SCHULCO

SITE#	STREAM	TRIB TO	DATE	CROSSING STRUCTURE		PASSABILITY RATING	ENTRANCE		EXIT	VELOCITY	OTHERS	EROSION PROBLEMS	
				BRIDGE	CULVERT		OUTFALL	TURBULENCE				FILL	DITCH
100	Warden Ck.	McLeod R.	June 7	+		Ex.	N/A	N/A	N/A	N/A	N/A		
101	Gregg R.	McLeod R.	24	+	-	Ex.	N/A	N/A	N/A	N/A	N/A		
103	Gregg R.*	McLeod R.	24		15' CMP	Imp.	2'*	*	*	*		*	
104	Berry's Ck.*	Gregg R.	24		Dual 5' CMP	Imp.	Dry-2'*	*	*	*		*	
105	Gregg R.	McLeod R.	24		12' CMP	Imp.	2'*	*	*	*		*	
106	Luscar Ck.	McLeod R.	24	+		Ex.	N/A	N/A	N/A	N/A	N/A		
107	Watson Ck.	McLeod R.	24		Dual 4' CMP	Imp	+						+
108	Felton Ck.	McLeod R.	6	+		Ex.	N/A	N/A	N/A	N/A	N/A		
109	White Ck.	McLeod R.	6		3' CMP	Imp.	2'						
110	McNeill Ck.*	Embarrass R.	6	+		Ex.	N/A	N/A	N/A	N/A	N/A	*	
111	Lambert Ck.	Embarrass R.	6	+		Ex.	N/A	N/A	N/A	N/A	N/A		
112	McLeod R.	Athabasca R.	6	+		Ex.	N/A	N/A	N/A	N/A	N/A		
113	Erith R.*	McLeod R.	8		Bridge Washout	Ex.	N/A	N/A	N/A	N/A	N/A	*	
114	Unnamed	Erith R.	8		Duel	Imp.	Dry-0		+		+		
115	Unnamed	Erith R.	8	+		Ex.	N/A	N/A	N/A	N/A	N/A		
116	Erith R.	McLeod R.	8	+		Ex.	N/A	N/A	N/A	N/A	N/A	+	
117	Caronte Ck.	Susa Ck. (Muskeg R.)	23		6' CMP	Imp.	+				+		
118	Mitayimin Ck.	Susa Ck.	23		2' CMP	Imp.	+				+		
119	Unnamed	Muskeg R.	23		6' CMP	Imp.	5'		+		+		
August													
120	Edson R.	Athabasca R.	8	+		Ex.	N/A	N/A	N/A	N/A	N/A		
121	Edson R.	Athabasca R.	8	+		Ex.	N/A	N/A	N/A	N/A	N/A		
122	Edson R.	Athabasca R.	8	+		Ex.	N/A	N/A	N/A	N/A	N/A		
123	Edson R.	Athabasca R.	8		5' CMP	Poor	Slight	+		+		+	
124	Unnamed	Edson R.	8		2' CMP	Good			+				
125	Unnamed	Edson R.	8		2' CMP	Imp.	6"				*	+	
126	Unnamed*	Edson R.	8		2' CMP	Good					+	+	*
127	Unnamed*	Edson R.	8		No crossing structure	Poor	N/A	N/A	N/A	N/A	+	+	*
128	Unnamed*	Edson R.	8		2' CMP	Imp.			+		+	+	*

SITE#	STREAM	TRIB. TO	DATE	CROSSING STRUCTURE		PASSABILITY RATING	CULVERT PROBLEMS					EROSION PROBLEMS	
				BRIDGE	CULVERT		ENTRANCE		EXIT	VELOCITY	OTHERS	FILL	DITCH
							OUTFALL	TURBULENCE					
August													
129	Unnamed*	Edson R.	8	Washout		Imp.	N/A	N/A	N/A	N/A	*	*	*
130	Unnamed	Edson R.	8	2' CMP		Good							
131	Unnamed*	Pine Ck.	7	Dual (5'-5' CMP)		Imp.	1 1/2' *-6"			+	+	*	*
132	Unnamed*	Pine Ck.	7	Dual (1 1/2'-2' CMP)		Imp.	Dry-1'					+	*
133	Unnamed	Pine Ck.	7	Small Culvert		Good							+
134	Pine Ck.*	Athabasca R.	7	Dual (6'-6' CMP)		Poor	1'-1'*			+	*		
135	Unnamed	Pine Ck.	7	Dual (1 1/2'-1 1/2' CMP)		Imp.	Dry-6"						
136	Pine Ck.*	Athabasca R.	7	+		Ex.	N/A	N/A	N/A	N/A		+	*
137	Pine Ck.*	Athabasca R.	7	+		Ex.	N/A	N/A	N/A	N/A			*
138	Unnamed*	Nosehill Ck.	7	Culvert Washout		Imp.	N/A	N/A	N/A	N/A	N/A	*	*
139	Unnamed	Nosehill Ck.	7	Culvert Washout		Imp.	N/A	N/A	N/A	N/A	N/A	*	*
140	Unnamed*	Nosehill Ck.	8	2' CMP		Good						*	*
142	Unnamed	Warden Ck.	9	12' CMP		Good							
144	Warden Ck.*	McLeod R.	9	Triple (5' CMP)		Poor	6"-6"-0			+	*	*	+
145	Embarrass R.*	McLeod R.	10	? CMP		Good	0				+	*	*
146	Unnamed*	Erith R.	10	? CMP		Imp.	8"					+	*
147	Unnamed*	McLeod R.	10	4' CMP		Imp.	6'				+	*	*
149	Unnamed	Anderson Ck.	10	4' CMP		Ex.							
150	Unnamed	Anderson Ck.	10	? CMP		Imp.	8"		+				+
152	Unnamed	Gregg R.	10	? CMP		Imp.							
153	Unnamed	Gregg R.	10	15' CMP		Good							
154	Gregg R.	McLeod R.	10	+		Ex.	N/A	N/A	N/A	N/A	N/A		
155	Anderson Ck. A.W.R.P.	McLeod R.	10	Dual (4'-4' CMP)		Imp.	4"-8"						
156	Unnamed*	Anderson Ck.	10	5' CMP		Good	0						*
157	Unnamed	Anderson Ck.	10	4' CMP		Fair	Slight				+		
158	Unnamed	McLeod R.	10	Old Log Bridge Poor Condition		Good	N/A	N/A	N/A	N/A	N/A		
159	Anderson Ck.	McLeod R.	10	5' CMP		Imp.	1'						
160	Quigley Ck. A.W.R.P.	McLeod R.	10	5' PA		Ex.							+



SCHULCO



SCHULCO



SITE#	STREAM	TRIB. TO	DATE	CROSSING STRUCTURE		PASSABILITY RATING	CULVERT PROBLEMS			EROSION PROBLEMS			
				BRIDGE	CULVERT		ENTRANCE OUTFALL	TURBULENCE	EXIT	VELOCITY	OTHERS	FILL	DITCH
August													
162	Unnamed*	Center Ck.	11		3' CMP	Good				+		+	*
163	Unnamed*	Canyon Ck.	11		2' CMP	Good				+		+	*
164	Canyon Ck.* A.W.R.P.	Athabasca R.	11		3' CMP	Good				+		+	*
165	Unnamed*	Canyon Ck.	11		2' CMP	Imp. (Blocked)	+		*		*	+	*
166	Unnamed*	Canyon Ck.	11		? CMP	Imp. (Blocked)	+		*		*		*
167	Unnamed*	Canyon Ck.	11		? CMP	Imp. (Blocked)	+		*		*	*	*
168	Unnamed*	Canyon Ck.	11		2' CMP	Imp. (Blocked)	+		*		*	+	*
170	Unnamed	?	11		2' CMP	Imp.	1 1/2'						+
171	Unnamed*	Barbara Ck.	11		No culvert observed Fill seepage	Imp.	N/A	N/A	N/A	N/A	N/A	*	*
172	Unnamed	Oldman Ck.	11		3' CMP	Good							+
173	Unnamed A.W.R.P.	Fish Ck.	11		4' CMP	Imp.	2 1/2'					+	+
174	Unnamed*	Fish Ck.	11		2' CMP	Imp.	2'					+	*
175	Unnamed	Fish Ck.	11		3' CMP	Good							+
176	Center Ck.*	Athabasca R.	11		3 1/2' CMP	Imp.	1 1/2'					+	*
178	Unnamed*	Teitge Ck.	11		Dual (5'-3' CMP)	Imp.	Dry-1'				*	*	*
179	Pinto Ck.	Wildhay R.	11		7' CMP	Imp.	1 1/2'	+			*		*
180	Unnamed	Fox Ck.	12		7' CMP	Good					+	+	+
181	Fox Ck.	Little Berland R.	12		Ford	N/A	N/A	N/A	N/A	N/A	N/A		*
182	Unnamed	Smoky R.	12		Small diameter CMP	Imp.							
183	Unnamed	Simonette R.	14		Dual (24" CMP)	Imp.			+			+	
185	Simonette R.	Smoky R.	14		Ford	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
186	Unnamed	Simonette R.	14		1 1/2' CMP	Imp.	5'					+	+
188	Unnamed	Simonette R.	14	+		Ex.	N/A	N/A	N/A	N/A	N/A		
189	Unnamed	Simonette R.	14	+		Ex.	N/A	N/A	N/A	N/A	N/A		
190	Unnamed	Simonette R.	14	+		Ex.	N/A	N/A	N/A	N/A	N/A		
191	Unnamed	Simonette R.	14	+		Ex.	N/A	N/A	N/A	N/A	N/A		
193	Simonette R.	Smoky R.	14		Ford	Ex.	N/A	N/A	N/A	N/A	N/A	N/A	N/A



APPENDIX II-7

LEGEND

- (+) indicates presence of a particular structure or feature; no quantitative description.
- () indicates structure or feature not observed at this site.
- (*) (when attached to a particular crossing feature) indicates that the feature is a substantial problem capable of deteriorating the fishery of that stream or of the parent stream.
- (*) (when attached to the stream name) indicates that one or more problems are associated with the stream crossing.

Culvert type - (CMP) circular metal pipe (corrugated)
(PA) pipe arch (closed)

Passability Rating - (IMP) impassable
(Poor) poor
(Fair) fair
(Good) good
(Ex.) Excellent

Culvert Problems - Outfall
(2'-Dry) - indicates dual culvert installation;
two foot outfall on one; other high
and dry.

(A.W.R.P.) - indicates that the stream is included in
the Alberta Watershed Research Program.

APPENDIX II-8

FUR PRODUCTION
IN THE
HINTON, EDSON AND GRANDE PRAIRIE REGIONS,
1971-72 SEASON

APPENDIX II-8

FUR PRODUCTION IN THE HINTON, EDSON AND GRANDE PRAIRIE REGIONS, 1971-72 SEASON*

	<u>HINTON</u>		<u>EDSON</u>		<u>GR. PRAIRIE</u>		<u>TOTAL</u>	
	<u>SKINS</u>	<u>REVENUE</u>	<u>SKINS</u>	<u>REVENUE</u>	<u>SKINS</u>	<u>REVENUE</u>	<u>SKINS</u>	<u>REVENUE</u>
Beaver	154	\$2254.86	787	\$13,056.33	2242	\$37,194.78	3183	\$52,805.
Lynx	4	140.00	34	1,190.00	698	24,430.00	736	25,760.
Squirrel	4368	2446.08	5140	2,878.40	17504	9,802.24	27012	15,126.
Coyote	37	515.04	158	2,199.36	190	566.40	385	5,359.
Muskrat	65	112.45	618	1,069.14	1532	2,650.36	2215	3,831.
Mink	24	338.88	93	1,313.16	77	1,087.24	194	2,739.
Marten	33	415.47	119	1,498.21	59	742.81	211	2,656.
Fisher	4	96.00	8	192.00	51	1,224.00	63	1,512.
Wolf	8	377.60	11	519.20	12	566.40	31	1,463.
Weasel	73	46.72	440	281.60	597	382.08	1110	710.
Wolverine	3	224.40	3	224.40	2	149.60	8	598.
Bear			7	160.50	9	206.37	16	366.
Fox	2	20.84	4	41.68	3	31.26	9	93.
Otter			1	26.21	1	26.21	2	52.
Badger			1	7.11			1	7.
TOTAL	4775	\$7267.50	7424	\$24,657.30	22977	\$81,138.15	35176	\$113,062.
NO. OF TRAPLINES	28		75		162		265	
AVERAGE REVENUE PER TRAPLINE	\$259.55		\$328.76		\$500.85		\$426.65	

*Data obtained from the Fish and Wildlife Division,
Alberta Department of Lands and Forests.

Minor discrepancies in addition were noted, but not
corrected.

APPENDICES

CHAPTER III



APPENDIX III-1

SUMMARY OF PROVISIONS
OF
FOREST MANAGEMENT AGREEMENTS

SUMMARY OF PROVISIONS OF FOREST MANAGEMENT AGREEMENTS



SCHULCO

Item

Agreement between Minister of Lands and Forests and:	NORTH WESTERN PULP AND POWER LTD. (NWPP)	NORTH CANADIAN FOREST INDUSTRIES LTD. (NCFI)	PROCTER AND GAMBLE CO. OF CANADA LTD. (PG)
ORIGINAL DATE:	September 14, 1954	May 26, 1964	January 3, 1969
SUBSEQUENT REVISIONS:	1. Aug. 30, 1968 (pro- posed mill expansion and augmentation of timber supply area). 2. Oct., 1971 (reversion to original Lease area in absence of accept- able expansion program.	Aug. 10, 1971 (augmen- tation of Lease area to include Peace and Puskaskau lands outside study area).	none
IN EFFECT UNTIL:	Aug., 1988. Renewable for further 20 year periods.	May, 1985. Renewable for further 21 year periods.	Jan., 1989. Renewable for further 20 year periods.
TOTAL LANDS INCLUDED:	3,070 sq. mi. (all in study area)	1,270 sq. mi. (880 in study area)	5,100 sq. mi. (4,780 in study area)
ANNUAL ALLOWABLE CUT (CURRENTLY IN EFFECT BUT NOT STATED OR GUARANTEED IN AGREEMENT):	Pulpwood: 380,000 cords, or 32,300 M C.F.	Sawlogs: 112,000 cords, or 9,500 M C.F., or 50 MM B.M. (about 44 MM B.M. in study area)	Pulpwood: 545,000 cords, or 46,325 M C.F. Less: 40,000 cord - equiv. for saw- log sales. (Net: 505,000 cords, or 42,925 M C.F.).

Item

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PG

PURPOSE OF AGREEMENT:



Utilization of Crown forests, to support pulp production. (Now a 500 tpd. bleached kraft pulpmill and a 50,000 M B.M. per year sawmill.)

Utilization of Crown forests, to support plywood and lumber production. (Now a 65 MM ft²/yr. plywood plant and sawmills cutting 80,000 M B.M./yr.)

Utilization of Crown forests, to support pulp production. (A 750 tpd. bleached kraft mill to start production in 1973.)

DEFINITIONS:

"Department"
"Minister"
"Forest Management Area"
"cunit", "cord",
"dollar"
"Improvements" (other terms as defined in Forests Act 1961, Public Lands Act (1966) and regulations thereunder.)

"Director"
"Public Lands"
"Forest Management Lease Area" (other words as defined in Forests Act (1961) and regulations thereunder.)

"cord", "cunit",
"dollar"
"Department"
"Minister"
"Forest Management Area"
"Provisional Reserve Area"
"Merchantable coniferous tree" (5 inch + d.b.h., 12-foot stick to 4-inch top diameter)
"Merchantable coniferous stand" (8 cords or more per acre of merchantable coniferous trees). (Other terms as defined by Forests Act (1961), Public Lands Act (1966) and regulations.)

LEASE AREA INCLUDES:

Map outline less:
(a) existing or pending alienations or dispositions of land or resources (Forests or Public Lands Acts).

Map outline less:
existing or pending dispositions.

Same as NWPP.

ItemNWPPNCFIPG

EASE AREA
INCLUDES:
cont'd.)



SCHULCO

(b) Lands below high water.

LAND ADDITIONS:	Lands which are vacated can become part of Lease.	Same as NWPP.	Same as NWPP.
LAND WITHDRAWALS BY MINISTER:	(a) Lands whose logging will substantially harm waterways or roads.	(a) Lands adjacent to waterways or public roads.	Same as NWPP.
	(b) Lands required for essential alternate development.	(b) Recreational, park, road, municipal, or resort sites.	
		(c) Industrial sites.	
		(d) Future dispositions under Public Lands Act.	
		(e) Lands whose logging will substantially harm waterways or roads.	
COMPENSATION FOR LANDS WITHDRAWN:	(a) Private users pay Co. for loss or damage of timber, improvements, regeneration.	(a) Payment for loss of Co. improvements or reforestation projects.	Same provisions as NWPP, except that replacement lands are "nearest available public timber lands" not identified.
	(b) Crown use (under 1% of area). Same compensation as in (a).	(b) Replacement with adjacent public lands, if productive capacity of FMA reduced by over 0.5%.	

Item

NWPP

NCFI

PG

COMPENSATION
R LANDS
THDRAWN:
(cont'd.)

(c) Crown use (over 1% of area) same, plus allowance for increased costs of alternate harvesting. Equivalent replacement area from Unit E-11 to be added to FMA.

PROVISIONAL
RESERVE AREA:

Not provided.

(a) Specified lands reserved for 15 years (except for 1-year cutting permits), to supplement proven expansion needs beyond FMA and purchased wood supplies.

(b) Provision for partial forfeiture after 1979 under certain conditions.

(c) Provision, on proof of need, of up to 1,000 sq. mi. beyond FMA and Provisional Reserve.

RIGHTS OVER
LAND:

1. Company Rights:
(a) Entry and use to grow and harvest timber.
Entry and use to reforest, or to manage, cut, and remove timber.

1. Similar to NWPP terms, but with extra limitations on Minister's disposition of specified public lands close to mill site.

Item

RIGHTS OVER



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NWPPNCFIPG

- (b) Co. is an "occupant" under Rights of Entry Arbitration Act.
- (c) Co. rights to sand and gravel under specified terms.
2. Minister's rights to allow:
2. Minister's rights to allow:
- (a) Public access for travel and recreation, subject to safety, fire, and road protection restrictions.
- (a) Continuance of existing cutting rights of others.
- (b) Geological or geophysical exploration, with fair compensation for timber damages.
- (b) Issuance of new temporary cutting permits.
- (c) Maintenance of quota cutting, issuance of new cutting permits up to 0.5% of allowable cut, and provision for cutting by others of E-11 wood unclaimed by NWPP.
- (c) Geological or geophysical exploration, with fair compensation for timber.
3. Consolidation of old NCFI timber licences into FMA.

Item

REST
MANAGEMENT:



SCMULCO

NWPP

NCFI

PG

1. General

1. General

1. General

NWPP will:

(a) Practice sound forestry, sustained yield management, and control of annual or periodic cut.

(a) Similar to NWPP.

(a) Similar, but emphasizes that cutting is confined to merchantable coniferous trees and stands.

(b) Submit Management Plans periodically for approval.

(b) Similar to NWPP.

(b) Same as NWPP.

(c) Formulate mutually agreed Ground Rules for approval and periodic review. Merchantability standards can be redefined periodically.

(c) No Ground Rules, but AFS supervision as on Quota operations.

(c) Same as NWPP, except that merchantability standards are defined for term of agreement.

(d) Submit Annual Operating Plans promptly for approval. These will include reforestation and forest protection plans.

(d) Similar to NWPP.

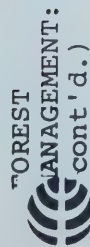
(d) Same as NWPP.

(e) Conduct surveys for forest management planning.

(e) Similar to NWPP.

(e) Same as NWPP.

Item



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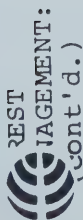
NWPP

NCFI

PG

- | | | |
|---|---|---|
| (f) Achieve optimum use of timber cut, subject to needs of pulpmill. | (f) N/A | (f) Same as NWPP. |
| (g) Purchase wood from others, subject to quality, price and need. | (g) Similar to NWPP (Sec. 28). | (g) Same as NWPP. |
| (h) Have option of harvesting deciduous stands or relinquishing the right to others. | (h) No provision for deciduous cutting. | (h) Same as NWPP. |
| (i) Have options to purchase timber quota or to benefit from quota cutting of others. | (i) No special provisions. | (i) Same as NWPP, with new clause which obliges PG to cut and offer for sale up to 40,000 cord-equivalents of sawlogs (not less than 10% of pulpwood cut. |
| (j) Have assurance that quota operations on the FMA will conform to sound forestry practices, will not interfere with NWPP operations, and will not be interfered with. | (j) No mention. | (j) Same as NWPP, with added undertaking that Minister will require others in area to harvest all pulpwood where economic. |

Item



ECMULCO

NWPP

- (k) Salvage fire killed or diseased timber at Minister's request, or relinquish salvage to others.

NCFI

- (k) Same as NWPP.

PG

- (k) Same as NWPP.

2. Reforestation:

- (a) Company cutovers still NSR after 7 years will be restocked over next 3 years at Co. expense. Co. will provide seed. Minister will provide free planting stock or will pay equivalent cost for company-provided stock.

2. Reforestation:

- (a) Same as NWPP.

2. Reforestation:

- (a) Same as NWPP.

- (b) Co. and Minister will share cost of "supplemental reforestation" program on a specified minimum annual proportion of NSR lands not cutover by NWPP, except those lands cut by others after creation of the FMA.

- (b) Not specified in agreement, but NCFI is reforesting NSR on area, from whatever source, at Co. cost.

- (b) Same as NWPP, with added phrase making deciduous restocking acceptable for supplemental reforestation purposes. Minister is also authorized to curtail a year's program for budget reasons.

Item



RECORDS AND
SCALING:

NWPP

All scaling by Co., with option of volumetric scaling or weighing and sample-scaling. Records to be kept in prescribed form, subject to periodic inspection. Quarterly returns to Minister of wood production, and dues payable. Periodic reporting of wood sold or purchased.

NCFI

Similar to NWPP. (Bulk of scaling is for sawlogs and peelers. NCFI now weighs and sample-scales by mutual consent.)

PG

Similar to NWPP.

CHARGES, DUES
AND RATES:

(a) Holding and forest protection charge \$15.80 per sq. mi. of FMA (less charges paid by others).

(a) Same as NWPP.

(a) Same as NWPP.

(b) Provision to adjust (a) for change in FMA or in value of dollar.

(b) Adjustment for change in FMA, but not for dollar value changes.

(b) Same as NWPP.

(c) Dues on pulpwood cut or destroyed other than by Crown or natural agencies:

(c) General Rates of Crown Dues prescribed by Lieutenant Governor in Council, plus 3-year weighted average overbid at public auctions of Crown timber. (This average overbid has been discontinued, by consent, in favour of the normal appraisal system.)

(c) Dues on pulpwood cut by Co. or others who must compensate Co.:

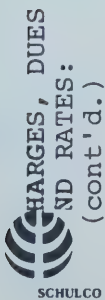
Coniferous \$1.00 per cord.

Coniferous \$1.15 per cord.

Deciduous \$0.45 per cord.

Deciduous \$0.50 per cord.

<u>NWPP</u>	<u>NCFI</u>	<u>PG</u>
3. <u>Forest Protection:</u>	3. <u>Forest Protection:</u>	3. <u>Forest Protection:</u>
(a) Fire protection organization and suppression at Government cost, aimed at keeping annual burnt acreage below 0.1% of FMA area.	No stipulations made in Agreement, other than expression of intent to enter into a forest protection agreement. NCFI complies normally with the Acts and regulations governing forest protection.	(a) Same as NWPP, except that no target for limiting burnt acreage is specified.
(b) Limited NWPP liability for suppression costs on fires caused by NWPP.		(b) PG liability for suppression costs is unlimited until a Forest Protection Agreement is signed.
(c) Neither party liable for fire losses incurred by the other party.		(c) Same as NWPP.
(d) Joint cooperation on control of insect or disease epidemics.		(d) Same as NWPP.
(e) There is a Forest Protection Agreement covering details.		(e) Forest Protection Agreement may be signed in future.

Item

CHARGES, DUES
AND RATES:
(cont'd.)

NWPP	NCFI	PG
(d) Provision for annual adjustment of pulp-wood dues after ten years, based on change in pulp market.	(d) Frequent, automatic adjustment through appraisal system.	(d) Similar to NWPP, with arbitrary 33% upper limit to increase at time of first renewal in 1989.
(e) Dues as prescribed for wood used other than for pulp.	(e) General rates apply to various end-uses.	(e) Same as NWPP.
(f) Provision for eventual lump sum payment of dues based on allowable annual cut rather than on scaled volume. This would be by mutual agreement, and would exclude payment for wood not merchantable under Ground Rules, or wood generated by voluntarily improved forestry practices of Co.	(f) No alternative to payment based on volume scaled.	(f) Same as NWPP.
(g) Provision for reduction of annual charges or dues to match those set by future Agreements with other pulp companies.	(g) "Matching" clause not applicable.	(g) "Matching" clause similar to NWPP.

Item

CONSTRUCTION:

<u>NWPP</u>	<u>NCFI</u>	<u>PG</u>
(a) Initial (completed by 1955): A \$5 million pulp-mill near Hinton, with capacity 100 tons per day.	(a) Initial: Maintenance of plants in Alberta, costing at least \$5 million, capacity equivalent to at least: 45 million sq. ft. (3/8") of plywood per year, and 30 million board feet of lumber per year.	(a) Initial (in production by July, 1973): A bleached kraft mill near Grande Prairie, with minimum capacity of 600 tons per day, costing at least \$50 million.
(b) Expansion (construction commenced by January, 1971): Additional pulp capacity costing at least \$50 million and increased by at least 1,000 tons per day. (This provision not fulfilled.)	(b) No specified subsequent expansion program.	(b) No specified future expansion program.
(a) \$25,000, still held by Minister, with bond interest to Co.	(a) \$25,000, with bond interest to Company.	(a) \$100,000, with bond interest to Company, to be reduced to \$50,000 on commencement of construction of mill.

DEPOSIT:

Item



DEPOSIT:
cont'd.)

SCHULCO

NWPP

NCFI

PG

(b) Provisions for forfeiture and rejection of Annual Operating Plans upon Company default of Agreement (six-month period to remedy default).

(b) Same as NWPP.

(b) Same as NWPP (clauses for partial recovery of deposit upon withdrawal from project have now expired).

CANCELLATION
OF AGREEMENT:

Provisions for cancellation by Minister on 90-day notice for:

Same as NWPP.

Same as NWPP.

Bankruptcy of Co.

Failure to fulfill agreement or remedy defaults.

ARBITRATION
OF DISPUTES
OVER INTER-
PRETATION OF
AGREEMENT:

Referred to arbitration under Arbitration Act, at instance of either party.

Same as NWPP.

Same as NWPP.

ASSIGNMENT OF
AGREEMENT
(Apart from
normal
contracting):

Only on Minister's consent.

Same as NWPP.

Same as NWPP.

ItemGENERAL PROVISIONS:NWPP

(a) Standard clauses to establish that:

Minister guarantees no timber quality or quantity.

Minister is not liable for acts of Company or its agents.

(b) Provisions for serving of notice to either party.

(c) Provisions for water diversion to mill, and for effluent treatment and discharge as approved by Prov. Board of Health. Capital cost of treatment facilities in excess of \$4.1 million to be borne by Government.

NCFI

(a) Same as NWPP.

(b) Same as NWPP.

(c) Provisions for minimizing soil erosion or damage.

PG

(a) Same as NWPP.

(b) Same as NWPP.

(c) Provisions for water diversion to mill, and for effluent treatment and discharge as approved by Prov. Board of Health. Capital cost of treatment facilities:

First \$4.1 million
- Co.
Next \$3.2 million
- Govt.
Further costs
- 2/3 Co. and
- 1/3 Govt.

APPENDIX III-2

RECONCILIATION OF CURRENT WOOD REQUIREMENTS
AND PROBABLE CAPACITY OF NWPP FMA

APPENDIX III-2

RECONCILIATION OF CURRENT WOOD REQUIREMENTS AND PROBABLE CAPACITY OF NWPP FMA

A. Wood Requirements (Conversion factors from NWPP)

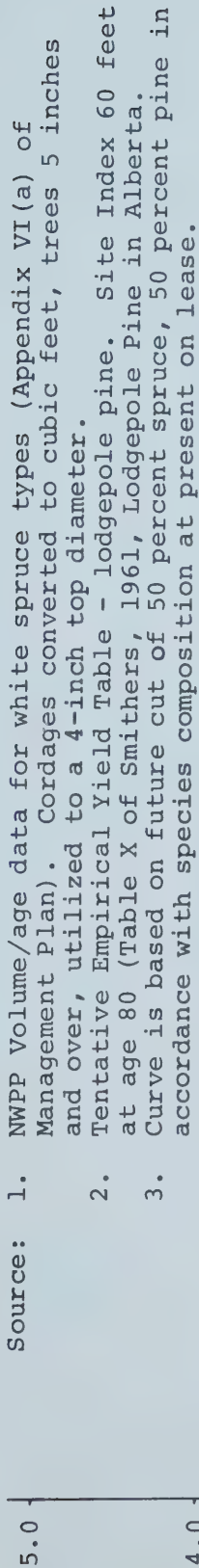
	Lumber M B.M. /Year	Bleached Kraft Pulp A.D.T./Year	Cord Equivalents Per Year	Roundwood, Cords Per Year	Roundwood M C.F./Yr. (.085 M C.F. Per Cord)
Sawmill (5.6 M B.M./M C.F. Sawn)	50,000			105,060	8,930
Pulpmill (575 ADT/Day, 347 Days/Year, 1.75 Cords/ADT)		200,000		350,000	
<u>Less:</u> Purchased Wood and Chips (34,000 Cords Currently)			34,000		
Sawmill Chips (3.40 Cord-Equiv./M C.F. Sawn)			30,360		
TOTAL OUTSIDE WOOD				64,360	
<u>Net:</u> Pulpwood Cut From FMA				285,640	24,280
TOTAL NWPP CUT FROM FMA				390,700	33,210
Unrecovered Seismic Drain				25,000	2,125
TOTAL ANNUAL DRAIN FROM FMA				415,700	35,335
					(Rounded to 35,400)

Total annual wood requirements are estimated in (A). Composite yield tables for coniferous species are curved in (B). An area-volume check, using logical procedures, is performed in (C).

RECONCILIATION OF CURRENT WOOD REQUIREMENTS AND PROBABLE CAPACITY OF NWPP FMA

APP-III-2/2

B. Composite Yield Curve For Conifers - NWPP FMA





RECONCILIATION OF CURRENT WOOD REQUIREMENTS
AND PROBABLE CAPACITY OF NWPP FMA

ea-Volume Check of Coniferous Cut of 35,400 M C.F. Per Year

Age Class	Acres (Conif.)	Age When Cut (Years)	Gross Yield (M C.F./Ac.) (10,042,500 Cords)	Net Yield Factors		Net Volume To Cut		Years to Cut		Acres Bared Per Year
				Fire Loss (0.1%/Year Cumulative) (1-(.001x18))	Cull, Submerch., Green Belts	Per Acre (M C.F.)	Total (M C.F.)	Class	Cum.	
106+	385,811	(Mature)	2.282	.982	.750	1.681	648,548	18.3	18.3	21,020
100	47,589	118-121(119)	3.660	.979	.750	2.687	127,889	3.6	21.9	13,220
90	87,414	111-117(114)	3.600	.973	.750	2.627	229,645	6.5	28.4	13,450
80	125,202	108-117(112)	3.580	.963	.750	2.586	323,730	9.1	37.5	13,760
70	245,811	107-125(116)	3.620	.945	.750	2.566	630,672	17.8	55.3	13,800
60	294,430	115-136(125)	3.700	.924	.750	2.564	754,948	21.3	76.6	13,820
50	73,175	126-131(128)	3.740	.921	.750	2.583	189,011	5.3	81.9	13,810
40	29,517	121-123(122)	2.690	.916	.750	2.535	74,826	2.1	84.0	13,960
30	17,972	114-115(114)	3.600	.915	.750	2.470	44,400	1.3	85.3	14,330
10 (Av.)	120,148	95-103(99)	3.400	.907	.750	2.313	277,884	7.8	93.1	15,300
	<u>1,427,069</u>						<u>3,301,553</u>	<u>93.1</u>		

Total Coniferous 1,427,069
Total Hardwood 180,178
TOTAL PROD. 1,607,247

Remarks:

1. New stands following clearcutting must develop similarly to fire-origin stands which are the basis of the yield curve.
2. Utilization of deciduous species, or salvage of fire-killed conifers, augmentation of chip purchases, and cessation of seismic losses would provide safety factors.
3. The 12-year lag in commencement of the second rotation is prudent until reforestation techniques are more universally successful.

APPENDIX III-3.1

SUMMARY OF PROCTER & GAMBLE
FORESTRY GROUND RULES (JANUARY, 1973)



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APPENDIX III-3.1

SUMMARY OF PROCTER & GAMBLE FORESTRY GROUND RULES (JANUARY, 1973)

1. Interpretation

Rules cover general case, consultation on special cases.

2. Expiry - December 31, 1973

3. Classification and Protection of Watercourses

(See also "Crossing" below.)

a) Main Watercourses

- Roads and landings not within five chains of stream bank, unless approved.
- Cutting not within three chains unless approved.
- If cutting approved, machines not within one chain.
- Debris removed from stream bed.

b) Secondary Watercourses

(Similar to Main Watercourses, except cutting allowed to within 1.5 chains of bank.)

c) Other (Intermittent) Watercourses

- No roads within watercourse.
- Debris and obstructions removed.

Classification and Protection of Lakes

a) No Recreation, Waterfowl, or Fish Potential

- Roads and landings not within five chains of shoreline.
- Cutting not within three chains (lakes 40 acres or over in area) without special approval.
- If approved, machines not within one chain.
- Debris removed.

b) Potential for Waterfowl or Fish

(Similar to a) except that three-chain cutting limitation applies to lakes 10 acres or over in area.)

c) Lakes with Recreation Potential

- Individual recreation reserve marked by AFS.
- Cutting only by AFS, with log purchase at option of company.
- Deletion from FMA area at company request.

Highway Margins

- Snags felled.
- Prompt treatment to remove slash or debris.

Forest Road Standards (subject to consultation)

a) Location

- Steep grades avoided or erosion-proofed.
- AFS consent, company liability, and special measures on flood plain locations.

b) Construction and Maintenance

- Limitations on bared width.
- Rules governing right-of-way brush disposal.
- Rules governing drainage installations.
- Rules governing cut and fill slopes.
- Rules governing maintenance of roads and landings.

c) Stabilizing, Retirement, or Restoration of Roads

- Revegetation within one year of road completion or skidding.
- Unused roads "put to bed".
- Filter strips between roads and adjacent streams.

Stream Crossings

- Proposed crossings approved by AFS.
- Written AFS approval for crossings which alter streams. Ample time for interdepartmental consultation.
- Approval by Forest Superintendent in emergencies.
- Crossings designed for peak flows, with erosion or sedimentation minimized, and prompt restoration of flood damage.

Borrow Pits

- Minimum number, and restoration when use terminates.

Forest Management

a) Cutting System

- Clear-cutting under normal conditions.

- Priority for more decadent stands.
- Cut boundaries located to minimize windfall.
- Fifty percent cut, 50 percent leave, on area basis within sub-watershed, with regard for optimum natural restocking.

b) Cut Planning

- i) Special salvage measures.
- ii) "Gentle zone" (slope less than 25 percent)
 - fifty percent cut, 50 percent leave, within sub-watershed;
 - pine clearcuts average 350 acres, maximum 500 acres;
 - spruce (with special reforestation provisions, (see h) below) clearcut width not more than 10 chains.
- iii) "Steep zone" (slope 25 percent or more, or fragile)
 - fifty percent cut, 50 percent leave, within sub-watershed;
 - clearcut width 15 chains along slope;
 - relaxation of 15-chain Rule where substantial deciduous cover will remain.
- iv) Both zones
 - "6 to 8-foot, 20-year Rule"* applies for watershed game, and aesthetic purposes;

*Cutting of residual blocks delayed until height of regenerating dominants from first cut averages 6 to 8 feet, or until satisfactorily restocked and 20 years have elapsed since first cut.



- prompt removal of qualifying residual blocks;
- retention of contingency wood blocks.

c) Provisions for Field Modification of Plans

d) Merchantability

- merchantable coniferous tree: 5 inches and over in d.b.h., with 12-foot stick to 4-inch top d.i.b.;
- merchantable stand: 8 cords per acre or more, composed of merchantable coniferous trees, based on type average.

e) Road Right-of-way Cutting

- covered by Cutting Plan;
- timber removed before road construction.

f) Inaccessibility

- slopes greater than 45 percent inaccessible, with provisions for local judgement.

g) Site (Slash) Treatment

- scarification of hazard abatement within 24 months of harvesting.

h) Special Reforestation Provisions for Spruce

- i) If seed crops adequate in 1973, 1974, or 1975:
 - seed collection for 7-year supply from first good seed crop;
 - site preparation within 24 months of harvest;

- regeneration surveys in fourth year after cutting, and seedlings ordered;
 - N.S.R. scarified and seeded in fifth year;
 - resurvey in seventh year;
 - remaining N.S.R. planted with large seedlings in seventh year;
 - resurvey in tenth year for clearance to commence second cut.
- ii) If adequate seed crop before 1975:
- concentration of cutting on non-spruce sites;
 - trial spruce cuts on ten-chain strip width;
 - re-evaluation of spruce block sizes;
 - retention of spruce blocks in unscarified state until favorable seed year. Catch-up of treatment after first good seed crop.
- iii) If light spruce seed crops, priority collection program by Company.
- iv) Restocking Standards
- as per 1973 Timber Management Regulations.

APPENDIX III-3.2

CONSOLIDATED GROUND RULES

THE PROCTER & GAMBLE COMPANY OF CANADA LIMITED

FOREST MANAGEMENT AREA

JANUARY 1, 1973

(COPY)

PREPARED BY

ALBERTA FOREST SERVICE

DECEMBER 1972



SCHULCO

APPENDIX III-3.2

OPERATING GROUND RULES THE PROCTER & GAMBLE COMPANY OF CANADA LIMITED

I Stream or Watercourse Reserves - Each watercourse shall be classified into one of three categories: Main, secondary and other. Main and secondary watercourses shall be classified on a watercourse map. The three classes and reserve timber requirements for each are as follows:

(1) Main watercourses - major streams and rivers as designated on the watercourse map. Requirements:

(a) No roads, landings or bared areas to be located within 5 chains of the high water mark without the written approval of the Forest Superintendent,

(b) No disturbance of any kind and no removal of forest cover, within 3 chains of the high water mark except where specifically approved in writing following inspection by a Forest Officer,

(c) Where removal of forest cover within 3 chains is approved, no skidder, scarifier or other machine to operate within one chain of the high water mark. Timber in the one chain area to be removed by winching or other means such that the machine will remain outside the one chain strip,

(d) Any trees felled within the 3 chain area to be felled away from the watercourse, and no debris of any kind to be allowed to enter the watercourse. Any debris or trees which accidentally or inadvertently enter the watercourse shall be completely removed immediately (using winches) without the machine entering the watercourse.

(2) Secondary watercourses - small but permanent streams as designated on the watercourse map.

(a) No roads, landings or bared areas within 5 chains of the high water mark without the written approval of the Forest Superintendent,

(b) No disturbance of any kind, and no removal of forest cover, within 1.5 chains of the high water mark,

(Source: AFS)



(c) Where removal of forest cover within 1.5 chains is approved in writing by a Forest Officer, no skidder, scarifier or other machine to operate within one chain of the high water mark. Timber to be removed from the one chain area by winching or other means such that the machine will remain outside the one chain strip.

(d) Any trees felled within the 1.5 chain area to be felled away from the watercourse unless otherwise approved in writing by a Forest Officer, and no debris or slash to enter the watercourse. Any debris or trees which accidentally or inadvertently enter the watercourse shall be completely removed immediately (using winches) without the machine entering the watercourse.

(3) Other watercourses - generally definable only on the ground, not designated on the watercourse map.

The Department will request and discuss with the company any special treatment required regarding pertinent portions of other watercourses in any operating area prior to the approval of any annual operating plan or intermediate road or cutting plan submissions. The Department's proposals will be delineated for special safeguard by the company after mutual agreement.

(a) Wherever feasible, the company will not construct roads within such watercourses.

(b) Where road construction is required across or along such watercourses all obstructions must be removed after post logging treatment and erosion control measures will be implemented during construction and use in accordance with any road construction standards which may be officially established for the agreement area.

II Lakes - The Department will classify lakes with regard to their recreational, waterfowl, sport fishing potential and advise the company of the classification. Three general classifications will be recognized:

(1) Lakes and water bodies with little or no recreational, waterfowl, and sport fishing potential. Around these lakes no roads, landings or bared areas will be located within 5 chains of the high water mark without written approval of the Forest Superintendent. On lakes exceeding 40 acres in area there will be no timber removal or disturbance of any kind within 3 chains of the high mark except after inspection and approval by an officer of the Department. If such removal is approved, no machinery is to operate within one chain of the high water mark, trees are to be felled away from the water and no debris is to enter the water body.

(Source: AFS)

(2) Lakes and water bodies with waterfowl and sport fishing potential (equivalent to or in excess of CLI Class 1, 2, 3, or 4). These lakes will be identified on maps by the Alberta Forest Service by January 1, 1974. Around these lakes no roads, landings or bared areas will be located within 5 chains of the high water mark without written approval of the Forest Superintendent. On lakes exceeding 10 acres in area there will be no timber removal or disturbance of any kind within 3 chains of the high water mark, except after inspection and approval by an officer of the Department. If such removal is approved, no machinery is to operate within one chain of the high water mark, trees are to be felled away from the water and no debris is to enter the water body.

(3) Lakes and water bodies with recreational potential. The Alberta Forest Service will identify such lakes, and advise the company of them, probably on maps. The Forest Service will delineate the area to be reserved on the ground and on appropriate maps. Any timber removed from reserved areas will be removed by the Forest Service, and the company will have first refusal at current pulpwood prices to acquire the wood removed. Such reserved areas may be formally deleted from the agreement area at the request of the company.

III Highways - Timber in cut areas located along highways will be treated in the same manner as timber in other cut areas, except that the company will undertake to fell snags, and undertake prompt scarification or other reforestation treatment with a view to avoiding any unsightly accumulation of slash or debris.

IV Road Standards -

1. Location

A. Gradient

Grades shall be kept to a minimum wherever possible, but where steep grades are encountered special control measures may be required.

B. Reserves along Watercourses and Lakes -

Refer to Sections I and II.

C. Major Flood Plains

Wherever road construction is proposed on a flood plain, the Forest Service and the company will mutually determine whether or not an alternative route is available. When it is agreed that an alternative route is not available construction employing maximum erosion control will be allowed. At any time after construction has been completed, should any problems occur in the way of damage to the watercourse caused by company negligence in building or maintaining the road, the company must take immediate action towards rectification.

(Source: AFS)



SCHULCO

2. Construction and Maintenance

A. Right-of-way Widths

(a) Other than in approved cut blocks, where the right-of-way is pre-logged in advance of construction, right-of-way widths shall be no wider than is necessary for construction of the specified class of road (see App. III-5). On any R.O.W., the surface that is bared to mineral soil shall be kept within the limits specified by the formula appended to Appendix III-5 unless otherwise approved. The limits stipulated in Appendix III-5 and by the formula are applicable only on level ground, and it is recognized that reasonable increases to the maximum limits stated in the table will be necessary under adverse topographic conditions.

B. Brush Disposal

(a) Debris disposal shall be as specified in Appendix III-5, and conducted in accordance with the requirements of the Forest Protection Regulations.

(b) Brush shall not be buried along sides of R.O.W. so as to create mounds.

(c) Where debris is to be buried on a right-of-way it shall be buried and compacted underneath the original ground surface, or under road grade or ditch line.

C. Road Drainage

Proper drainage shall be incorporated into road construction, to minimize erosion on the road surface, on the cut and fill slopes or in the ditches.

Note: In order to achieve this requirement the following will be required in many instances:

(a) Frequent culverts, off take slopes and ditches to minimize water movement along ditches and road surfaces.

(b) Drainage structures should be of sufficient size to accommodate peak flows from the drainage area.

(c) No ditches shall drain directly into water-courses unless limited by topography. Ditch blocks to be installed where required.

(d) Special erosion control measures may be required on fills or cuts greater than 20 feet to reduce bank erosion, including such measures as contour trenches or terracing.

(Source: AFS)

(e) Culverts shall be rip-rapped, as necessary, to prevent erosion at both inflow and outflow ends.

(f) The outflow ends of hanging culverts shall be provided with down spouts or other suitable drains. Rock or concrete aprons shall be provided to decrease water velocity and prevent stream channel gouging.

(g) No significant stream diversions shall be constructed unless approved under the Water Resources Act.

(h) Culverts or other drainage devices should be placed at an angle to the road so as to attain maximum drainage efficiency.

D. Cross Sections

(a) Except on rock cuts, cut and fill slopes shall be as specified in Appendix III-5.

(b) Road slopes shall be regular in profile from the top of the cut to the bottom of the ditch, with no hanging banks and no sharply cut ditches.

(c) On unstable back slopes merchantable timber shall be removed for a distance back from top of cut - distance to be determined by conditions.

E. Road Maintenance

All roads shall be maintained in such a manner to allow proper drainage and to prevent erosion.

F. Landings

The requirements for location, drainage and revegetation of landings shall be the same as those for roads, where applicable.

3. Retirement and Restoration

Studies have shown that erosion and sedimentation are most serious during and immediately after construction. Detrimental effects can, however, continue or even increase as a road ages, unless corrective measures are taken.

(a) Bared surfaces on roads in use shall be subject to the specifications of Appendix III-5 as regards revegetation. (Revegetation means a herbaceous cover adequate in density to minimize erosion. It may also include seeding to restore coniferous tree growth on areas where there is a minimal erosion-sedimentation hazard. Establishment of this cover may require, aside from seeding,

(Source: AFS)



fertilizing, mulching, contour trenching, or other means of slope stabilization.)

(b) Restoration treatment is to be applied within one year of construction except where timber will be skidded to the road in which case treatment will be applied within one year of the completion of skidding.

(c) Roads which will not be used will either be "put to bed" in a manner which will minimize erosion or given maintenance for drainage and erosion prevention so that no significant erosion will occur.

(d) Filter strips which will not effectively prevent the movement of sediment into watercourses shall be provided with a system of obstructions (e.g. logs, rocks, mounds or depressions) placed between the road drainage outlet and the watercourse as approved.

4. Application of Guidelines

The above guidelines are designed to outline the minimum standards desired to fit average or normal conditions. They are not intended to be strictly applied as rigid specifications, or used as substitutes for judgement or experience. There will undoubtedly be exceptions or unusual conditions to which the standards will not apply. Adjustments will then be required, using the standards as aids or guides.

It is expected that these standards will be adhered to unless stipulated in annual operating plans or otherwise approved.

A Forest Officer has the authority to waive or amend the application of these rules in any single specific instance, provided he does so in writing.

V. Stream Crossings

The stream or watercourse reserves stipulated in Part I do not apply where a stream is being crossed, however, the following rules apply:

(a) All proposed crossings of main and secondary streams must be shown in the annual operating plan or request for road construction approval.

(b) In cases where crossings do not alter the stream bed or water flow and earth work on banks is small, it will not be necessary to obtain specific approval for the method or manner of stream crossing, once the road plan showing the crossing has been approved.

(Source: AFS)



(c) When stream alteration work is contemplated, the company shall first seek written approval of the Forest Superintendent. A detailed plan and description shall be required and should be submitted on the understanding that ample time will be required for a detailed study by any one or a number of government agencies.

(d) Any situations deemed to be an emergency shall also require the company to seek the approval of the Forest Superintendent.

Under emergent conditions, it is understood it will not be possible to provide detailed plans but the company will still be required to provide the best information available. The Grande Prairie Office of the Alberta Forest Service is hereby delegated authority to approve all emergency actions but the said Grande Prairie Office reserves the right to consult Head Offices over any special problems before granting approval or amending or rejecting the application. As an example, it would be permissible for the Grande Prairie Office of the Alberta Forest Service to approve the use of a dragline to pick up the odd sweeper or pile of debris situated in the immediate vicinity of bridge piers or so located as to menace a road-side.

(e) Bridge piers should be as far apart as possible, a principal factor to be taken into account being the examination of records of water flow prepared by the Federal and/or Provincial Departments concerned and in the event that such records are not available on estimates of maximum flow rates based on the area of the drainage basin or other appropriate data.

(f) All stream crossings and bridges shall be located and constructed so as to cause a minimum of erosion damage and sediment deposit in stream channels and corrective measures are to be implemented as soon as possible.

VI Borrow Pits and Gravel Pits

The company shall periodically review the location and number of borrow and gravel pits and implement a restoration program (sloping-revegetation-erosion control) on pits which are no longer required.

The company shall minimize the number of borrow pits and gravel pits developed for road construction and maintenance to avoid the development of unnecessarily large numbers of pits.

(Source: AFS)



SCHULCO

VII Forest Management

A. Basic Cutting System

The basic cutting system to be adopted shall be clear cutting; nevertheless, this shall not preclude the employment of stand improvement, shelterwood, experimental or other cutting systems.

Wherever feasible, the less thrifty timber shall be removed in the first cut and wind and other hazards shall be minimized by the use of borders of natural openings and by other means in setting out cutting perimeters.

To promote water regulation and erosion control, to minimize areas of continuous slash and reduce susceptibility to destructive agencies, no more than approximately 50% of the area of merchantable timber shall be operated in any one cut. Also the acreage and arrangement of blocks, patches and strips designated to be cut over or retained as a seed source shall be established in such a manner as to promote the establishment of natural regeneration of desirable species in adequate numbers and satisfactory distribution.

B. Cut Planning

The general cut planning approach is to be described in an approved management plan, but particularly, the following apply:

(1) In any case where significant blowdown, infested, diseased, or endangered timber is found throughout the Forest Management Area the company shall give consideration to harvesting this timber and may propose to the Director of Forestry for approval an appropriate harvesting plan which may differ from the prescribed management and cutting systems.

(2) For a period of time, the following system of management will be practiced on the Forest Management Area:

The Forest Management Area will be divided into two zones, namely the Steep and Gentle Zones.

In the Gentle Zone clearcuts where management is for pine should average no more than 350 acres and a maximum block size of 500 acres will be permitted. No more than 50 percent of the area of any sub-watershed may be harvested during the initial cut. Where special reforestation provisions are agreed to, the Department will agree to cut blocks with a maximum size of 250 acres on spruce site, or larger than 250 acres under exceptional circumstances where there is justification. In the gentle zone where special reforestation provisions are not to be applied, spruce site will require strip or block widths to be no greater than 10 chains with no area restriction.

(Source: AFS)



In the Steep Zone characterized by slopes exceeding 25 percent or highly erodable areas regardless of slope, cutting areas will be situated on the contour with a maximum width of 15 chains measured slope distance. No more than 50 percent of the area of any sub-watershed may be harvested during the initial cut.

In coniferous-deciduous mixtures where considerable amounts of poplar will be left standing, the maximum strip width may be increased, on the condition that subsequent reforestation treatment on these areas will provide for the retention of the existing poplar cover.

In both zones, to assure adequate watershed protection, adequate cover for game populations, and to optimize the aesthetics of cutover areas, height of regeneration dominants must average 6 to 8 feet before removal of residual timber would be approved. A maximum retention period of residual blocks would be 20 years assuming that minimum stocking of regeneration is present.

Residuals must at all times be harvested as soon as they are available if they are in sufficient quantity to warrant an economical year's operation.

Whenever possible initial cuts should be removed in the first ten years of operation in any operating area, preferably sooner.

(3) Contingency wood will be identified as such by the company and will be retained until such time as there is an emergency need for this wood to be removed. These contingency blocks will be reviewed as the road network progresses and block substitutions will be made in an ongoing fashion. A proper number of suitable blocks will, at all times, be held as contingency wood.

C. Field Modifications

Reasonable field modifications of cutting blocks (including rights-of-way) will be accepted on condition that the company notifies the Forest Superintendent in triplicate and in detail to his satisfaction immediately following such changes being effected and prior to the commencement of any cutting concerned with such changes.

All Class A, B and C roads will be mapped to within 4 chain accuracy of final field location. All D, E and F class roads will be mapped to within 5 chain accuracy of the final field location. In addition, Class D, E and F roads which are wholly confined within a cutting block will be approximately mapped in each Annual Operating Plan but it is understood that the actual locations may be changed by the company as dictated by ground conditions providing the ground rules are adhered to.

(Source: AFS)



D. Minimum Standards of Merchantability

No stand is considered merchantable unless:

(i) it has 8 cords or more per acre of merchantable coniferous trees, and

(ii) a merchantable coniferous tree is one having a minimum 5 inch d.b.h. and a minimum 12 foot usable length to a 4.0 inch top diameter measured inside bark.

Once a stand is classified as merchantable, it will be operated in such a way as to effectively utilize all of the merchantable coniferous trees in the stand.

The above minimum standards of merchantability are applicable to cutting blocks including rights-of-way on the basis of type averages.

Any individual stand which does not meet the specifications described in items (i) and (ii) above does not have to be cut even if it occurs within the perimeter of an approved cutting block. Any stand may be left uncut even if it is located within the perimeter of an approved cut block providing such stand is at least 10 acres in area and is comprised of timber which is thrifty and will remain healthy through to the end of the next harvesting rotation. The interior of any residual stand left within a cut block must not be disturbed or the Director may require removal of the stand.

E. Road-side Cutting

The cutting of timber on new roads shall be covered by a cutting plan and the timber shall be removed prior to actual road construction.

F. Inaccessibility

Forty-five percent shall be adopted initially as the rough division between accessible and inaccessible slopes. Individual situations will be dealt with taking into account the nature of the slope, the soil, timber volumes to be extracted and type of logging equipment contemplated.

G. Site Treatment

The cut over areas shall be allowed to remain unlopped and not scattered providing such areas shall be scarified or otherwise treated for fire hazard abatement no later than 24 months following the month in which harvesting was completed, and these cut over areas shall be adequately designated on cut layout maps and on the ground.

(Source: AFS)



H. Special Reforestation Conditions for Spruce

- (A) In the event of a seed crop in 1973, 1974 or 1975,
- 1) enough seed will be collected to last for at least 7 years of operations.
 - 2) Within two years of cutting, the seedbeds will be prepared and then:
 - a) Cutover regen. surveyed in 4th year and necessary seedlings ordered.
 - b) Unsatisfactory areas rescarified and reseeded in 5th year.
 - c) Resurveyed in 7th year.
 - d) All unsatisfactory areas retreated in 7th year by planting with large seedlings.
 - e) Cutovers resurveyed in 10th year to obtain block clearance if not obtained earlier.
- (B) In the event that there is no cone crop in spruce over the next three years and no seed is on hand:
- 1) Wherever feasible, attempts will be made to concentrate cutting for spruce in stands which are not designated as being on typical spruce sites (i.e. pine/spruce mixtures and aspen/spruce mixtures).
 - 2) Some typical spruce sites will be cut on a 10 chain strip basis experimentally, to assess the merits of this system of cutting.
 - 3) The large clearcut (250 acres) concept for spruce will be re-evaluated in consultation with the Department of Lands & Forests at the end of the 3-year period if no seed crop is in sight.
 - 4) Pure spruce stands will not be scarified until seed is available from seed band and/or adjacent trees. This implies that backlog areas be treated by doubling up on reforestation load (area) until the backlog is caught up with.

(Source: AFS)

- (C) In the event that there is even a light seed crop in spruce within or outside of the agreement area over the next few years, the company will make a priority effort to collect this seed in sufficient quantities to start a large seed bank.

1. Reforestation Stocking Standards

As prescribed by the Department in Regulations.

(Source: AFS)

APPENDIX III-3.3

CONSOLIDATED GROUND RULES
NORTH WESTERN PULP & POWER LTD.

FOREST MANAGEMENT AREA

JANUARY 1, 1973

(COPY)

PREPARED BY
ALBERTA FOREST SERVICE

DECEMBER 1972

APPENDIX III-3.3

OPERATING GROUND RULES

NORTH WESTERN PULP & POWER LTD.

I Stream or Watercourse Reserves - Each watercourse shall be classified into one of three categories: Main, secondary and other. Main and secondary watercourses shall be classified on a watercourse map. The three classes and reserve timber requirements for each are as follows:

(1) Main watercourses - major streams and rivers as designated on the watercourse map. Requirements:

(a) No roads, landings or bared areas to be located within 5 chains of the high water mark without the written approval of the Forest Superintendent,

(b) No disturbance of any kind and no removal of forest cover, within 3 chains of the high water mark except where specifically approved in writing following inspection by a Forest Officer,

(c) Where removal of forest cover within 3 chains is approved, no skidder, scarifier or other machine to operate within one chain of the high water mark. Timber in the one chain area to be removed by winching or other means such that the machine will remain outside the one chain strip,

(d) Any trees felled within the 3 chain area to be felled away from the watercourse, and no debris of any kind to be allowed to enter the watercourse. Any debris or trees which accidentally or inadvertently enter the watercourse shall be completely removed immediately (using winches) without the machine entering the watercourse.

(2) Secondary watercourses - small but permanent streams as designated on the watercourse map, in two colours, one denoting areas of steep terrain and one denoting areas of gentle terrain. These colour designations will serve for general planning purposes and for allowable cut calculation. In practice, gentle terrain will be defined for each location as it exists in the field. Grades of 25 percent and less will be defined as gentle.

(a) No roads, landings or bared areas within 5 chains of the high water mark without the written approval of the Forest Superintendent.

(Source: AFS)



(b) No disturbance of any kind, and no removal of forest cover, within 1.5 chains of the high water mark except in areas of gentle terrain where neither bank is strongly sloped, where removal may be allowed up to the high water mark following inspection and approval in writing by a Forest Officer.

(c) Where removal of forest cover within 1.5 chains is approved in areas of gentle terrain, no skidder, scarifier or other machine to operate within one chain of the high water mark. Timber to be removed from the one chain area by winching or other means such that the machine will remain outside the one chain strip.

(d) Any trees felled within the 1.5 chain area to be felled away from the watercourse unless otherwise approved in writing by a Forest Officer, and no debris or slash to enter the watercourse. Any debris or trees which accidentally or inadvertently enter the watercourse shall be completely removed immediately (using winches) without the machine entering the watercourse.

(3) Other watercourses - generally definable only on the ground, not designated on the watercourse map.

The Department will request and discuss with the company any special treatment required regarding pertinent portions of other watercourses in any operating area prior to the approval of any annual operating plan or intermediate road or cutting plan submissions. The Department's proposals will be delineated for special safeguard by the company after mutual agreement.

(a) Wherever feasible, the company will not construct roads within such watercourses.

(b) Where road construction is required across or along such watercourses all obstructions must be removed after post logging treatment and erosion control measures will be implemented during construction and use in accordance with any road construction standards which may be officially established for the agreement area.

II Lakes - The Department will classify lakes with regard to their recreational, waterfowl, sport fishing potential and advise the company of the classification. Three general classifications will be recognized:

(1) Lakes and water bodies with little or no recreational, waterfowl, and sport fishing potential. Around these lakes no roads, landings or bared areas will be located within 5 chains of the high water mark without written approval of the Forest Superintendent. On lakes exceeding 40 acres in area there will be no timber removal or disturbance of any kind within 3 chains of the high mark except after inspection and approval by an officer of the Department. If such removal is approved, no machinery is to operate within one chain of

(Source: AFS)



the high water mark, trees are to be felled away from the water and no debris is to enter the water body.

(2) Lakes and water bodies with waterfowl and sport fishing potential (equivalent to or in excess of CLI Class 1, 2, 3, or 4). These lakes will be identified on maps by the Alberta Forest Service by January 1, 1973. Around these lakes no roads, landings or bared areas will be located within 5 chains of the high water mark without written approval of the Forest Superintendent. On lakes exceeding 10 acres in area there will be no timber removal or disturbance of any kind within 3 chains of the high water mark, except after inspection and approval by an officer of the Department. If such removal is approved, no machinery is to operate within one chain of the high water mark, trees are to be felled away from the water and no debris is to enter the water body.

(3) Lakes and water bodies with recreational potential. The Alberta Forest Service will identify such lakes, and advise the company of them, probably on maps. The Forest Service will delineate the area to be reserved on the ground and on appropriate maps. Any timber removed from reserved areas will be removed by the Forest Service, and the company will have first refusal at current pulpwood prices to acquire the wood removed. Such reserved areas may be formally deleted from the agreement area at the request of the company.

III Highways - Timber in cut areas located along highways will be treated in the same manner as timber in other cut areas, except that the company will undertake to fell snags, and undertake prompt scarification or other reforestation treatment with a view to avoiding any unsightly accumulation of slash or debris.

IV Road Standards -

1. Location

A. Gradient

Grades shall be kept to a minimum wherever possible, but where steep grades are encountered special control measures may be required.

B. Reserves along Watercourses and Lakes

Refer to Sections I and II.

C. Major Flood Plains

Wherever road construction is proposed on a flood plain, the Forest Service and the company will mutually determine whether or not an alternative route is available. When it is agreed that an alternative route is not available construction employing

(Source: AFS)



maximum erosion control will be allowed. At any time after construction has been completed, should any problems occur in the way of damage to the watercourse caused by company negligence in building or maintaining the road, the company must take immediate action towards rectification.

2. Construction and Maintenance

A. Right-of-way Widths

(a) Other than in approved cut blocks, where the right-of-way is pre-logged in advance of construction, right-of-way widths shall be no wider than is necessary for construction of the specified class of road (see App. III-6). On any R.O.W., the surface that is bared to mineral soil shall be kept within the limits specified by the formula appended to Appendix III-6 unless otherwise approved. The limits stipulated in Appendix III-6 and by the formula are applicable only on level ground, and it is recognized that reasonable increases to the maximum limits stated in the table will be necessary under adverse topographic conditions.

B. Brush Disposal

(a) Debris disposal shall be as specified in Appendix III-6, and conducted in accordance with the requirements of the Forest Protection Regulations.

(b) Brush shall not be buried along sides of R.O.W. so as to create mounds.

(c) Where debris is to be buried on a right-of-way it shall be buried and compacted underneath the original ground surface, or under road grade or ditch line.

C. Road Drainage

Proper drainage shall be incorporated into road construction, to minimize erosion on the road surface, on the cut and fill slopes or in the ditches.

Note: In order to achieve this requirement the following will be required in many instances:

(a) Frequent culverts, dips and/or out-slopes to minimize water movement along ditches and road surfaces.

(b) Drainage structures should be of sufficient size to accommodate peak flows from the drainage area.

(c) No ditches shall drain directly into watercourses unless limited by topography.

(Source: AFS)



(d) Special erosion control measures may be required on fills or cuts greater than 20 feet to reduce bank erosion, including such measures as contour trenches or terracing.

(e) Culverts shall be rip-rapped, as necessary, to prevent erosion at both inflow and outflow ends.

(f) The outflow ends of hanging culverts shall be provided with down spouts or other suitable drains. Rock or concrete aprons shall be provided to decrease water velocity and prevent stream channel gouging.

(g) No stream diversions shall be constructed unless approved under the Water Resources Act.

(h) Culverts or other drainage devices should be placed at an angle to the road so as to attain maximum drainage efficiency.

D. Cross Section

(a) Except on rock cuts, cut and fill slopes shall be as specified in Appendix III-6.

(b) Road slopes shall be regular in profile from the the top of the cut to the bottom of the ditch, with no hanging banks and no sharply cut ditches.

(c) On unstable back slopes merchantable timber shall be removed for a distance back from top of cut - distance to be determined by conditions.

E. Road Maintenance

All roads shall be maintained in such a manner to allow proper drainage and to prevent erosion.

F. Landings

The requirements for location, drainage and revegetation of landings shall be the same as those for roads, where applicable.

3. Retirement and Restoration

Studies have shown that erosion and sedimentation are most serious during and immediately after construction. Detri-mental effects can, however, continue or even increase as a road ages, unless corrective measures are taken.

(Source: AFS)



(a) Bared surfaces on roads in use shall be subject to the specifications of Appendix III-6 as regards revegetation. (Revegetation means a herbaceous cover adequate in density to minimize erosion. It may also include seeding to restore coniferous tree growth on areas where there is a minimal erosion-sedimentation hazard. Establishment of this cover may require, aside from seeding, fertilizing, mulching, contour trenching, or other means of slope stabilization.)

(b) Restoration treatment is to be applied within one year of construction except where timber will be skidded to the road in which case treatment will be applied within one year of the completion of skidding.

(c) Roads which will not be used will either be "put to bed" in a manner which will minimize erosion or given maintenance for drainage and erosion prevention so that no significant erosion will occur.

(d) Filter strips which will not effectively prevent the movement of sediment into watercourses shall be provided with a system of obstructions (e.g. logs, rocks, mounds or depressions) placed between the road drainage outlet and the watercourse as approved.

4. Application of Guidelines

The above guidelines are designed to outline the minimum standards desired to fit average or normal conditions. They are not intended to be strictly applied as rigid specifications, or used as substitutes for judgement or experience. There will undoubtedly be exceptions or unusual conditions to which the standards will not apply. Adjustments will then be required, using the standards as aids or guides.

It is expected that these standards will be adhered to unless stipulated in annual operating plans or otherwise approved.

V Stream Crossings

The stream or watercourse reserves stipulated in Part I do not apply where a stream is being crossed, however, the following rules apply:

(a) All proposed crossings of main and secondary streams must be shown in the annual operating plan or request for road construction approval.

(b) In cases where crossings do not alter the stream bed or water flow and earth work on the banks is small, it will not

(Source: AFS)



be necessary to obtain specific approval for the method or manner of stream crossing, once the road plan showing the crossing has been approved.

(c) When stream alteration work is contemplated, the company shall first seek written approval of the Forest Superintendent. A detailed plan and description shall be required and should be submitted on the understanding that ample time will be required for a detailed study by any one or a number of government agencies.

(d) Any situations deemed to be an emergency shall also require the company to seek the approval of the Forest Superintendent.

Under emergent conditions, it is understood it will not be possible to provide detailed plans but the company will still be required to provide the best information available. The Edson Office of the Alberta Forest Service is hereby delegated authority to approve all emergency actions but the said Edson Office reserves the right to consult Head Offices over any special problems before granting approval or amending or rejecting the application. As an example, it would be permissible for the Edson Office of the Alberta Forest Service to approve the use of a drag-line to pick up the odd sweeper or pile of debris situated in the immediate vicinity of bridge piers or so located as to menace a road-side.

(e) Bridge piers should be as far apart as possible, a principal factor to be taken into account being the examination of records of water flow prepared by the Federal and/or Provincial Departments concerned and in the event that such records are not available on estimates of maximum flow rates based on the area of the drainage basin or other appropriate data.

(f) All stream crossings and bridges shall be located and constructed so as to cause a minimum of erosion damage and sediment deposit in stream channels and corrective measures are to be implemented as soon as possible.

VI Borrow Pits and Gravel Pits

The company shall periodically review the location and number of borrow and gravel pits and implement a restoration program (sloping-revegetation-erosion control) on pits which are no longer required.

The company shall minimize the number of borrow pits and gravel pits developed for road construction and maintenance to avoid the development of unnecessarily larger numbers of pits.

(Source: AFS)



VII Forest Management

A. Basic Cutting System

The basic cutting system to be adopted shall be clear cutting; nevertheless, this shall not preclude the employment of stand improvement, shelterwood, experimental or other cutting systems.

Wherever feasible, the less thrifty timber shall be removed in the first cut and wind and other hazards shall be minimized by the use of borders of natural openings and by other means in setting out cutting perimeters.

To promote water regulation and erosion control, to minimize areas of continuous slash and reduce susceptibility to destructive agencies, no more than approximately 50% of the area of merchantable timber shall be operated in any one cut. Also the acreage and arrangement of blocks, patches and strips designated to be cut over or retained as a seed source shall be established in such a manner as to promote the establishment of natural regeneration of desirable species in adequate numbers and satisfactory distribution.

B. Cut Planning

(1) There will be five working circles recognized on the Forest Management Area namely the Athabasca, McLeod, Berland, Marlboro, and Embarras. The boundaries in each working circle will remain unchanged from those submitted with the June, 1966 Forest Management plan.

Each working circle will be managed in accordance with its annual allowable cut. The annual allowable cut will be determined separately for each working circle and the cut will be controlled within five year periods, so that the periodic cut will not exceed a volume equal to five times the annual allowable cut.

(2) In any case where significant blowdown, infested, diseased, or endangered timber is found throughout the Forest Management Area the company must give top harvesting priority to this timber and shall propose to the Director of Forestry for approval an appropriate harvesting plan which may differ from the prescribed management and cutting system.

(3) For a period of time, two systems of management will be practiced on the Forest Management Area. These are:

(a) Clearcutting to a maximum block or strip size of 80 acres with retention of residuals for a period of at least 10 years, after which the residuals may be released providing they are satisfactorily stocked with coniferous regeneration as per the Reforestation Stocking Standards in Item VII H. This system will be

(Source: AFS)



applicable to the first cycle compartments in the Athabasca and McLeod Working Circles. The only exception to this policy in the first cycle compartments of these two working circles will be those areas which the company or the department feel that the residual units should be retained for a period of longer than 10 years, for specific environmental reasons.

(b) Clearcutting to a maximum block size of 500 acres with retention of the residual blocks or strips until such time as the regeneration on the original cut areas has reached an average height of from 6 to 8 feet or the expiration of 20 years following the initial cut, whichever comes first. This system will be applied to all second, third and fourth cycle compartments and to first, second, third and fourth cycle compartments in the Marlboro, Embarrass and Berland Working Circles.

(i) In those areas where the new cutting system employing larger blocks is to be used the following management principles will apply.

(ii) The Forest Management Area will be divided into two zones, namely the Foothills and Lowland Zones.

(iii) In the Lowland Zone clearcuts in pine types and predominantly pine types should average no more than 350 acres and a maximum block size of 500 acres will be permitted. No more than 50 percent of the area of any sub-watershed may be harvested during the initial cut. Spruce types within the Lowland Zone will require strip or block width to be no greater than 10 chains with no area restriction.

(iv) In the Foothills Zone cutting area sizes will be limited to 20 chains maximum strip width in pine and 10 chains maximum strip or block width in spruce with no area restriction of strips or blocks. No more than 50 percent of the area of any sub-watershed may be harvested during the initial cut.

(v) To assure adequate watershed protection, adequate cover for game populations, and to optimize the aesthetics of cutover areas, height of regeneration dominants must average 6 to 8 feet before removal of residual timber would be approved. A maximum retention period of residual blocks would be 20 years assuming that minimum stocking of regeneration is present.

(vi) The compartments within each working circle will be redefined to more carefully encompass a uniformity of age classes. Ultimate size and number of individual compartments will no longer be critical. Compartments will then be allocated to cutting cycle primarily on the basis of harvesting the oldest age classes first.

(Source: AFS)



(vii) Residuals must at all times be harvested as soon as they are available if they are in sufficient quantity to warrant an economical year's operation.

(viii) Whenever possible initial cuts should be removed in the first ten years of operation in any compartment, preferably sooner.

(4) Any contingency wood which has been identified as such, must be retained until such time that it has been agreed that there is an emergency need for this wood to be removed. Where contingency wood is cut it will be replaced with areas which are loggable under a summer logging chance, and which are in close proximity to these major road systems should be identified and retained as contingency wood.

(5) Notwithstanding road construction, no second cycle compartment may be cut until such time that all initial cuts plus available residual blocks representing an economical operation in sufficient quantity to accommodate the allowable annual cut have been removed from all of the first cycle compartments within the same working circle. Roads should be developed in second cycle compartments three years prior to the commencement of logging operations in these compartments.

C. Field Modifications

Reasonable field modifications of cutting blocks (including rights-of-way) will be accepted on condition that the company notifies the Forest Superintendent in duplicate and in detail to his satisfaction immediately following such changes being effected and prior to the commencement of any cutting concerned with such changes. Wherever a major modification is involved a map delineating the modification must also be supplied. This clause also applies to areas contained within an approved cut block which for some reason cannot be feasibly logged.

D. Minimum Standards of Merchantability

No stand is considered merchantable unless:

(i) The average merchantable butt diameter, measured 9 inches from ground level, of all trees 5 inches butt diameter or greater, is 6.5 inches or larger in pine types, 7.0 inches or larger in black spruce and mixed spruce types and 7.5 inches or larger in white spruce and fir types.

(Source: AFS)

(ii) The minimum volume per acre, of all stems 5 inches butt diameter or greater, is 8 cords per acre, with minimum utilization limit to a 4 inch top diameter measured inside bark.

(iii) Nothing shall preclude the company from utilizing stands below this minimum standard if economical harvesting systems are developed by the company.

The above minimum standards of merchantability are applicable to cutting blocks including rights-of-way on the basis of type averages.

E. Road-side Cutting

The cutting of timber on new Class I, II, and III roads shall be covered by a cutting plan and the timber shall be removed prior to actual road construction.

F. Inaccessibility

Forty-five percent shall be adopted initially as the rough division between accessible and inaccessible slopes. Individual situations will be dealt with taking into account the nature of the slope, the soil, timber volumes to be extracted and type of logging equipment contemplated.

G. Site Treatment

The cut over areas shall be allowed to remain unlogged and not scattered provided such areas shall be scarified or otherwise treated for hazard abatement during the following operating year and shall be adequately designated on cut layout maps and on the ground.

H. Reforestation Stocking Standards

(1) Considering the year of cut as being the first year, the company shall complete and submit to the Director a reforestation survey which meets the specifications of the Director by the end of the seventh year for all areas they are obliged to reforest.

(2) The Director may establish qualifications and require any person undertaking a reforestation survey for submission to the Director to meet them.

(3) Considering the year of cut as being the first year and if, by the end of the seventh year, the Director decides that the new growth of tree seedlings is below the required standard the company shall carry out within the following year all the operations necessary to reforest to the required standard by the end of the tenth year.

(Source: AFS)



(4) For the purpose of determining whether or not an area is reforested to the required standard, it shall be considered to be subdivided into units of one-thousandth of an acre, called milacres.

(5) The Director may determine the boundaries of any area to be considered as a unit for the purpose of establishing whether or not it is reforested.

(6) In order for any area to be classified as reforested in accordance with the required standard:

- (a) Forty percent of the milacres it includes must contain an established seedling tree, and
- (b) Three-quarters or more of the established seedling trees must be spruce, pine or Douglas fir, and the other one-quarter or less must be balsam fir, birch or poplar seedling trees, and
- (c) It cannot contain any areas larger than 10 acres in extent which do not in themselves meet the required stocking standard, and
- (d) Identifiable areas larger than three acres which in themselves do not meet the required stocking standard must not in the aggregate exceed twenty percent of the total area to be classified.

(7) For the purpose of these ground rules the term "established seedling tree" means:

- (a) A live and healthy seedling tree which has grown in its present location at least three years, or
- (b) A sound, undamaged spruce, pine or Douglas fir tree under thirty years of age and located by nature which will probably be live and merchantable when the rest of the established seedling trees on the area are logged.

(8) Two live healthy seedling trees that have grown on the same milacre for two years are acceptable in substitution for an established seedling tree.

(Source: AFS)

(9) Where vigorous balsam fir has survived for seven years after logging and this same balsam fir exhibits good colour and shows significant height growth, such balsam fir may be accepted in lieu of spruce and pine regeneration where the Director of Forestry agrees that it would be unwise to remove the balsam fir in order to establish spruce or pine regeneration.

(Source: AFS)

APPENDIX III-3.4

THE GOVERNMENT OF
THE PROVINCE OF BRITISH COLUMBIA
PLANNING GUIDELINES FOR COAST LOGGING OPERATIONS

COPY

THE GOVERNMENT OF
THE PROVINCE OF BRITISH COLUMBIA

FOREST SERVICE
Victoria, British Columbia

September 29, 1972.

PLANNING GUIDELINES FOR COAST LOGGING OPERATIONS

A. The general practice shall be to clear-cut to the close utilization standards, with the objective of creating even-aged stands on the sites harvested. Logging must be conducted in such a manner that fire hazard is reduced to an acceptable standard and the cutting area is satisfactorily prepared for the future crop. In addition to cutting all species to a minimum diameter limit, falling of all trees ten feet and over in height, regardless of merchantability will normally be required.

Of great concern is the matter of protection of water quality and the maintenance of a managed environment suitable for the preservation, protection, and regulation of other users of the forest habitat. Measures must be taken to ensure that all protective forest cover is not removed, but rather that sufficient trees or blocks of forest are left to meet the necessary requirements of the other users. Protective cover requirements will vary with wildlife species present and their habitat requirements, size of stream, type of bed, water-flow continuity, the present or potential value for fish and game, human consumption, and recreational use. Wildlife and fish habitats of significance must receive special consideration. Normally, many different types of forest cover will be present over the greater percentage of any managed unit and they must be recognized and deliberately incorporated into area plans. These include:

- (1) inaccessible trees which occur in steep rocky canyons and on steep bluffs;
- (2) tree growth occurring on unstable, erodible cutbanks;
- (3) leaning trees along water-courses and shorelines which cannot be removed without causing environmental damage;
- (4) fast-growing deciduous trees of suitable species, not subject to extra-site encroachment, planted along water-courses or shorelines either prior to logging or after slash burning;
- (5) primary timbered leave strips for fire control and their replacements;

(Source: BCFS)

- (6) leave blocks which will not be cut until adjacent blocks are reforested to the stage required to assure compatible integrated use;
- (7) filter strips between roads or openings and waterfront or stream banks, held temporarily pending stabilization of run-off within the developed area;
- (8) pre-established second-growth timber or satisfactorily renewed immature stands resulting from earlier cutting or from other causes such as fires, and not forming part of present cutting areas;
- (9) forest cover in parks or other ownerships not being cut over;
- (10) needed wildlife corridor patches held pending re-positioning into renewed forests or alternative areas;
- (11) forest recreational use development areas;
- (12) forest utilized as "surround" for unique features;
- (13) forest temporarily held in pocket or strip for recreation areas, pending development and eventual re-positioning into alternative areas;
- (14) forest temporarily held on alternate "50 percent" cut program for watershed protection, held pending development of new forest on adjacent cut-over areas to the stage required to assure compatible integrated use.
- (15) stream-face or shoreline blocks subject to special treatment, stand improvement, or special cutting system.

Forest land within a watershed will be harvested under the multiple use concept. Consistent with the incorporation of forest recreation, game habitat, and watershed management into cutting plans designed to accommodate these and other resource uses, mature timber, extending to stream borders, may be harvested using such special measures as deemed necessary. These measures will prevent stand decadence and ensure the renewal of forest growth along water courses within a time sequence logical to a managed forest environment. Only in this way can quality stream maintenance, as well as the needs of people, be provided for simultaneously. Examples of using special measures where necessary may include: approved forms of selective cutting, cutting narrow strips or smaller patches, mechanical or

(Source: BCFS)

other powered methods of controlling the direction of tree fall, felling of trees from opposite banks and lifting clear to avoid environmental damage, etc. Such measures will often involve precise timing of critical operations, such as road and bridge development, stream clearing or improvement and other forestry operations that can best be done at certain times of the year, depending on the circumstances within the particular managed unit.

B. The size, shape and orientation of clear-cut openings shall be based on an analysis of forest regeneration, logging economics, fire protection, fish and wildlife production, soil protection, aesthetic appeal, water quality maintenance, etc. In other words, utilization of all resources and compatible integrated use shall dictate the size, shape, and orientation of each individual proposed opening. Normally, the openings should be kept as small as practicable and, as a basic guideline, the size of a clear-cut opening will not exceed 200 acres unless the aforementioned factors dictate otherwise.

C. Logging in deferred areas, adjacent to the initial clear-cut openings, will be considered when hazard has been abated and re-stocking requirements are met within the first opening and the maintenance of other resource values is assured.

D. Clear-cutting will be based on an alternate system of cut and leave patches. The location of the patches must be adjusted to meet the needs of other integrated uses. Also, an alternate patch system is required to reduce the potential for increased water temperature, sediment, and logging wastes that could reach perennial streams or lakes. The percentage of the total stream face or lake to be opened during any one phase of patch-logging will depend on the sensitivity of the particular area to logging disturbances. As a guide, no more than 50 percent of a stream or lake face will be opened during one phase. At no time during the same phase will two cut openings be permitted to face each other across a perennial stream unless the maintenance of other resource values has been assured.

E. All logging adjacent to streams, stream-beds, and lakes must be regulated so as to ensure there is no violation of stream protection requirements. Setting boundaries and yarding plans shall coincide with water-courses so that there is no yarding damage. The protection of water quality will normally require care and special measures in falling, bucking, and yarding away from the stream or lake, and cutting will not commence until the boundaries have been approved.

(Source: BCFS)



F. Cutting within approved openings adjacent to streams or lakes when required will be regulated so that a filter-strip adjacent to the stream or lake will be reserved until the last logging sequence within the opening. To effect good stream-bank clean-up, care and special measures will be taken in falling, bucking, and yarding away from the stream or lake.

G. Stands which would be uneconomic to treat will be excluded from within approved cutting boundaries unless their inclusion is necessary to the creation of the proper size, shape, and orientation of the treated site in its finished form. Similarly, certain stands or portions of stands which could be economically treated, but whose exclusion is required by the proposed pattern of cutting, will be excluded from the approved cutting boundaries.

H. Approval for further cutting in untouched stands will only be given where acceptable logging plans and utilization standards pertain to the timber in question and to any adjacent stands of lower value which should be logged. Rehabilitation planning for older partially logged or poorly stocked old growth forest must be co-ordinated with the plans for logging the adjoining standing green timber or it will be necessary for the proposed new cutting to be deferred to some future date.

I. All satisfactorily-stocked immature forests of manageable proportions surrounding or adjacent to mature merchantable timber will be reserved and protected.

J. All roads, (main roads, secondary roads, spur roads, and skid trails) must be planned, located, designed, constructed, used and maintained in such a manner that their impact on the total managed unit will be an acceptable minimum by:-

- (1) locating roads away from streams, narrow canyons, slide areas, and marshes;
- (2) locating roads on benches, ridge tops, and flatter slopes to minimize harmful disturbances and improve road stability;
- (3) prescribing for each road those design specifications that are best adapted to given slopes, topography, and soil materials;

(Source: BCFS)

- (4) disposing of the slash and debris concurrently with construction;
- (5) building culverts large enough to handle a 25-year frequency storm. Aprons or troughs should be installed where needed to carry runoff water over unstable fills to the undisturbed soil below the culvert;
- (6) minimizing soil disturbance in road construction by working only while soil moisture conditions are favourable (i.e. not too wet);
- (7) adopting regular maintenance programs which should include inspection and clearing of ditches and culverts as well as grading of roads;
- (8) constructing cross drains and water bars on skid trails, spur roads, and secondary roads to control and direct runoff which collects at the road, particularly away from creeks;
- (9) revegetating cutbanks and fill slopes where necessary in some areas to prevent erosion.

K. Operating plans and proposals are subject to approval prior to implementation and the Forest Service will consult with other resource managers to ensure that their input will assist in attaining the basic objective of maintaining an environment satisfactory and suitable to the needs of all British Columbians.

L. These guidelines are considered to be an essential facet to an effective base for planning, resource allocation and management of operations and constitute the minimum requirements for forward planning. However, they must not be construed as being absolute. Particular forest units, special circumstances, or needed objectives and policies will also dictate the resultant planning and treatment required for development and cutting plans.

(Signed by)
I.T. Cameron, R.P.F.
Chief Forester.

(Source: BCFS)

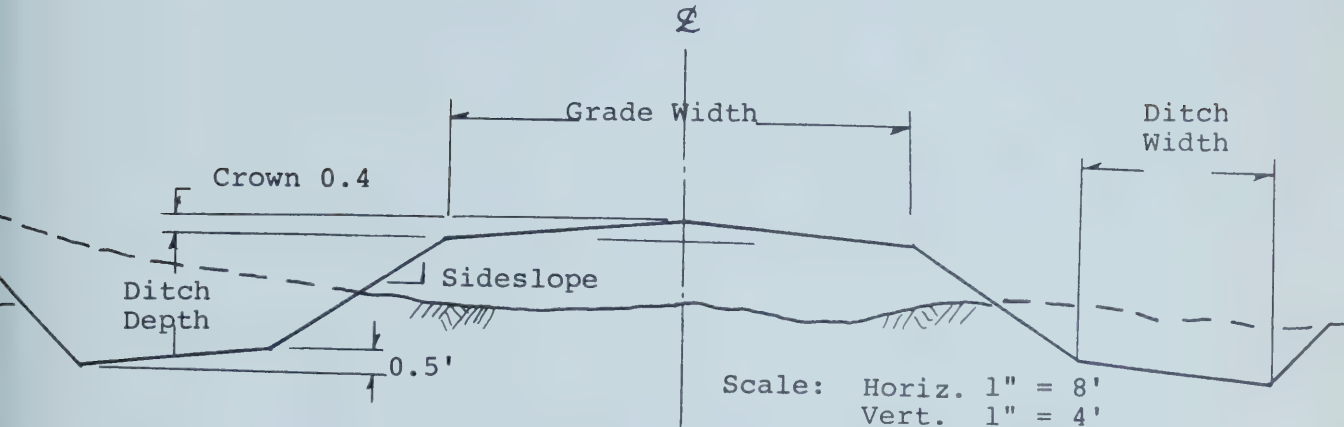


APPENDIX III-4

STANDARDS OF ALBERTA FOREST SERVICE
ON FORESTRY ROADS

APPENDIX III-4

STANDARDS OF ALBERTA FOREST SERVICE ON FORESTRY ROADS



SPECIFICATIONS FOR FORESTRY ROADS

<u>Dimension of Specification</u>	<u>Class 1</u>	<u>Class 2*</u>	<u>Class 3</u>
Grade Width	24 feet	20 feet	18 feet
Ditch Depth	3.5 feet	3.5 feet	1.5 feet
Ditch Width	10 feet	10 feet	"V" ditch
Side Slope	3:1	3:1	3:1
Back Slope	2:1	2:1	2:1
Right-of-way Width	100 feet	100 feet	66 feet
Maximum Grade	8 percent	10 percent	14 percent
Maximum Degree of Curve	10°	15°	-
Maximum Sight Distance	300 feet	200 feet	-
Gravel Width	20 feet	18 feet	Nil

*Note: No new construction of this class of road.



(Source: AFS)

APPENDIX III-5

PROCTER & GAMBLE ROAD STANDARDS

APPENDIX III-5

PROCTER & GAMBLE ROAD STANDARDS



Item	Road Classification					
	A (I) Trunk	B (II) Primary	C (III) Secondary	D (IV) Summer	E Winter I	F Winter II
1. R/W width Acres/mile Slopes	150' 18.18 2:1	150' 18.18 C 1-1/2:1 F 2:1	125' 15.15 Same P	100' 12.12 Min	100' 12.12 Same P	100' 12.12 Min
2. Grade width	34'	28'	22'	20'	18'	20'
3. Travel surface width	32'	26'	20'	18'	16'	20'
4. Gravel thickness base course	32'@ 3"	26'@ 3"	18' @ 3"	16'@ 3"*	-	-
5. Gravel thickness finish	32'@ 2"	26'@ 2"	18'@ 2"	-	-	-
6. Maximum adverse grade	4.2%	4.2%	6%	8%	8%	10%
7. Maximum favorable grade	6%	8%	8%	10%	10%	10%
8. Turn-out spacing Design speed	- 50 mph	3/4 mi -	1/2 mi -	- -	- -	- -
9. Sight distance	600'	450'	200'	-	-	-

*Gravel only if necessary

(Source: AFS)

DEFINITIONS OF ROAD CLASSIFICATIONS

- A - Trunk (I) - The first 41.5 miles of main haul road over which essentially all wood must be hauled.
- B - Primary (II) - Extension of the main haul road beyond the 40-mile corner, connecting all main camp operations, part of the permanent road system, may be converted into trunk roads as the needs justify.
- C - Secondary (III) - Roads leading into general areas of harvesting operation, semi-permanent in nature.
- D - Summer (IV) - Temporary, non-capital roads into specific timber stands, to be used primarily in summer harvesting operations. Gravel may or may not be used.
- E - Winter I - Temporary, non-capital roads into specific timber stands, to be used in winter harvesting operations only, but may be used over several winter seasons.
- F - Winter II - Temporary, non-capital roads into specific timber stands, to be used in only one winter season.

(Source: AFS)

PROCTER & GAMBLE ROAD STANDARD GUIDELINES
Specifications Apply on Level Ground

Road Class	A	B	C	D	E	F
Road Type	Trunk	Primary	Secondary	Tertiary (Summer)	Strip	Winter
Maximum Right-of-way Width	150'	150'	125'	125'	100'	100'
Brush Disposal	Complete Cleared to mineral soil 25 feet on each side of the running surface measured from the outside edge of the shoulder. <u>Ditch to be kept free of debris.</u> Balance of right-of-way to be cleared of all woody debris except stumps left in the ground. Accumulated debris to be disposed of by burning. Burying of unburned residue in approved locations as stipulated in the Forest Protection Regulations.	Complete Same as for Class A	Complete Same as for Class A	Cleared to mineral soil 15 feet on each side of the running surface measured from the outside edge of the shoulder. Ditch to be kept free of debris. Where traversing cut areas, balance of right- of-way to be scarified so that woody debris in the right-of-way is of no greater hazard than in the adjacent cut. Between cut blocks right-of-way to be cleared of all woody debris except stumps left in the ground. Accumulated debris to be disposed of by burning. Burying of unburned residue in approved locations as stipulated in the Forest Protection Regulations.	Debris to be scarified within two years of construction of the road.	Debris to be spread and crushed to lie flat on the ground on both sides of the running surface and to be confined within the right-of-way No leaning trees or windrows against the surrounding timber.

(Source: AFS)

PROCTER & GAMBLE ROAD STANDARD GUIDELINES
Specifications Apply on Level Ground

Road Class	A	B	C	D	E	F
Road Type	Trunk	Primary	Secondary	Tertiary (Summer)	Strip	Winter
Revegetation	All bared surfaces except the running surface of the road. Seed mixtures used for revegetation to be approved by the Director to ensure minimum fire hazard.	Same as for Class A	Same as for Class A	All areas subject to erosion. Seed mixture to be approved by the Director.	Same as for Class D	Same as Class D
Cut and Fill Slope	Cuts - maximum slope of 1-1/2.1 Fills - maximum slope of 2.1 Erosion control measures on cuts or fills exceeding 20 feet in depth	Same as for Class A	Same as for Class A	Cuts - maximum slope of 1-1/2.1 Fills - maximum slope of 1-1/2.1 Erosion control measures on cuts or fills exceeding 20 feet in depth.	Same as for Class D	Same as for Class D
Travel Surface Width Wider in Curves	32'	26'	20'	18'	16'	20'

(Source: AFS)

APPENDIX III-6

NORTH WESTERN PULP AND POWER ROAD STANDARDS

APPENDIX III-6

NORTH WESTERN PULP AND POWER ROAD STANDARDS

Design Standards

Purpose

Class "A" - permanent, all weather

Class "B" - semi-permanent (20 years) all weather

Class "C" - camp access (5 years) all weather

Class "D" - winter haul roads

Class "E" - compartment extraction roads

Geometric Design Standards

<u>Design Element</u>			<u>Road Class</u>				
			I	II	*	III	V
			<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>
Speed			40	30	20	30	30
Alignment Min. Rad. (ft)			573	383	250	383	383
Maximum) Gradient) Percent)	Favorable	Sustained	6	7	7	6	7
		Pitch	8	8	10	8	8
	Adverse	Sustained	3	3	3	3	3
		Pitch	5	5	5	5	5
Minimum sight distance			620'	420'	250'	420'	420'
Maximum right of way (ft)			132'	132'	132'	132'	132'
Width) (ft))	Roadbed		28'	28'	24'	28'	28'
	Ditch to Ditch		52'	48'	44'	-	48'
	Surfacing		28'	28'	24'	nil	28'
Fills	under 5 ft.		3:1 slope				
	over 5 ft.		1-1/2:1 slope				
Cuts	under 5 ft.		2:1 slope				
	over 5 ft.		1:1 slope				

Superelevation

<u>Radius</u>	<u>Superelevation</u>	<u>Transition Dist.</u>
250-700	.02 feet per foot	75 feet

*No longer used.



SCHULCO

NORTH WESTERN PULP & POWER ROAD STANDARD GUIDELINES
SPECIFICATIONS APPLY ON LEVEL GROUND

	CLASS I	CLASS II	CLASS III	CLASS IV	CLASS V
Description of Road	Inter-working Circle and Inter Compartment Main Haul Road	Inter-Compartment within a working Circle Secondary Haul	Internal Compartment Lateral Access through Cut Blocks Secondary Haul	Within or between Cut Blocks Strip Roads	Class II, III, or IV Roads - not useable in the summer months with a two-wheel drive vehicle. Winter Roads
Life of Road	Long Term Average over 20 years	Long Term 20 years Average	Medium Term Average 10 years	Short Term Generally less than 2 years	Depends on location Winter use only
Maintenance	High requirements	Fairly high requirements	Low requirements	Low to nil after construction	None - no grade nil to limited ditching
Maximum Right-of-way Total Width Level Ground	150 feet	132 feet	100 feet	66 feet	100 feet except for Class IV where 66 feet
Brush Disposal	Cleared to mineral soil 25 feet on each side of the running surface measured from the outside edge of the shoulder. Ditch to be kept free of debris. Balance of right-of-way to be cleared of all woody debris except stumps left in the ground. Accumulated debris to be disposed of by burning. Burying of unburned residue in approved locations as stipulated in the Forest Protection Regulations.	Same as for Class I	Cleared to mineral soil 15 feet on each side of the running surface measured from the outside edge of the shoulder. Ditch to be kept free of debris. Where traversing cut areas, balance of right-of-way to be scarified so that woody debris in the right-of-way is of no greater hazard than in the adjacent cut. Between cut blocks right-of-way to be cleared of all woody debris except stumps left in the ground.	Debris to be scarified within two years of construction of the road.	Debris to be spread and crushed to lie flat on the ground on both sides of the running surface and to be confined within the right-of-way. No leaning trees or windrows against the surrounding timber.

NORTH WESTERN PULP & POWER ROAD STANDARD GUIDELINES
SPECIFICATIONS APPLY ON LEVEL GROUND

	CLASS I	CLASS II	CLASS III	CLASS IV	CLASS V
			- continued: Accumulated debris to be disposed of by burning. Burying of unburned residue in approved locations as stipulated in the Forest Protection Regulations.		
Cuts and Fill Slopes	Cuts - maximum slope of 1-1/2.1 Fills - maximum slope of 2.1 Erosion control measures on cuts or fills exceeding twenty feet in depth.	Same as for Class I	Cuts - maximum slope of 1-1/2.1 Fills - maximum slope of 1-1/2.1 Erosion control measures on cuts or fills exceeding twenty feet in depth.	Same as for Class I	Minimal
Revegetation	All bared surfaces except the running surface of the road. Seed mixture used for revegetation to be approved by the Director to ensure minimum fire hazard.	All bared surfaces except the running surface of the road. Seed mixtures used for revegetation to be approved by the Director to ensure minimum fire hazard.	All critical slopes, cuts and fills. Seed mixture to be approved by the Director.	All critical slopes, cuts and fills. Seed mixture to be approved by the Director.	All critical bared slopes. Seed mixture to be approved by the Director.

Maximum area to be bared to mineral soil on level ground - See attached formula.

APPENDIX III-7

NCFI ROAD SPECIFICATIONS
(APPLYING TO CONSTRUCTION ON LEVEL GROUND)



APPENDIX III-7

NCFI ROAD SPECIFICATIONS (APPLYING TO CONSTRUCTION ON LEVEL GROUND)

DESCRIPTION of ROAD	CLASS I Main Haul Road	CLASS IIA Secondary Haul	CLASS IIB Not useable in the summer months with a two wheel drive vehicle - Winter Roads	CLASS III Spur roads within areas covered in detail by annual operating plan
Life of Road	Long Term Average over 20 years	Medium Term Average 10 years	Depends on Location Winter Use only	Short Term Generally less than two years
Maintenance	High requirements	Low requirements	None - no grade nil to limited ditching	Low to nil after construction
Maximum Right-of- way Total Width Level Ground	150 feet	132 feet	66 feet to 132 feet dependent on usage and life	66 feet
Brush Disposal	Cleared to mineral soil 20 feet on each side of the running surface measured from the outside edge of the shoulder. Ditch to be kept free of debris. Balance of right- of-way to be cleared of all woody debris except stumps left in the ground. Accumulated debris to be disposed of by burning. Burying of unburned residue in approved locations as stipulated in the Forest Protection Regulations.	Cleared to mineral soil 15 feet on each side of the running surface measured from the outside edge of the shoulder. Ditch to be kept free of debris. Where traversing cut areas, balance of the right-of-way to be scari- fied so that woody debris in the right-of- way is of no greater haz- ard than in adjacent cut. Between cut blocks right- of-way to be cleared of all woody debris except stumps left in the ground.	Debris to be spread and crushed to lie flat on the ground on both sides of the running surface and to be confined within the right-of-way. No leaning trees or windrows against the surrounding timber. Debris to be lopped so as to lie flat.	Same as Class IIB



DESCRIPTION of ROAD	CLASS I	CLASS IIa	CLASS IIb	CLASS III
Brush Disposal (continued)		Accumulated debris to be disposed of by burning. Burying of unburned residue in approved locations as stipulated in the Forest Protection Regulations.		
Cut and Fill Slopes	Cuts - maximum slope of 1k.1 Fills - maximum slope of 2.1 Erosion control measures on Cuts or Fills Exceed- ing Twenty Feet in Depth. All bared surfaces except the running surface of the road	Same as for Main Haul Road.	Minimal	Same as for Main Haul Road.
Maximum Area to be Bared to Mineral Soil level Ground	80 feet	All critical slopes, cuts and fills 60 feet	All critical bared slopes 40 feet	All critical slopes, cuts and fills. 40 feet

APPENDIX III-8

COMPILATION OF PHYSICAL ROAD STANDARDS

APPENDIX III-8

COMPILATION OF PHYSICAL ROAD STANDARDS

LEGEND

1. Alberta Forest Service (AFS)
2. Procter & Gamble (PG)
3. North Western Pulp & Power (NWPP)
4. Takla Logging Co. (TL)
5. Finlay Forest Ind. Ltd. (FFI)
6. Central Interior & Kootenays (CI&K)
7. B.C. Forest Service (BCFS)
8. MacMillan Bloedel (MM)
9. U.B.C. Research Forest (UBC-RF)
10. Eastern Canada - Quebec (ECQ)
11. U.S. Forest Service (USFS)
12. U.S. Forest Service - Pacific
Northwest Region (USFS-PNW)



APPENDIX III-8

COMPILATION OF PHYSICAL ROAD STANDARDS

APP-III-18

AGENCY	ROAD CLASS	DESIGN SPEED	R/W	GRADE WIDTH	LANE WIDTH	SURFACE WIDTH	SHOULDER WIDTH	BARRED WIDTH	ROADSIDE WIDTH	WIDENING	SIDE SLOPE	CUT SLOPE	FILL SLOPE	DITCH WIDTH	DITCH DEPTH	SURFACING DEPTH	BASE DEPTH	SUB-BASE DEPTH	CROWN SLOPE	SHOULDER SLOPE	MAX. FAV.	MAX. ADVERSE	VELOCITY GRADE	MAX. LENGTH OF PITCH	MIN. °C	DESIGN °C	MIS SIGHT DISTANCE	TURNOUT LENGTH	TURNOUT SPACING	CULVERT SPACING		
		ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
		ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
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		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	3	

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APPENDIX III-9

CURRENT REGULATION RATES OF CROWN DUES
FOR CONIFEROUS SAWTIMBER

APPENDIX III-9

CURRENT REGULATION RATES OF CROWN DUES

FOR CONIFEROUS SAWTIMBER

3-MONTH AVERAGE NET PRICE OF DIMENSION LUMBER AT PLANER MILL	GRADUATED PERCENTAGE OF MILL NET PRICE	GRADUATED RATE OF DUES PER M., F.B.M.
\$65.01 to \$67.00	5.0	\$3.30
67.01 to 69.00	5.5	3.75
69.01 to 71.00	6.0	4.20
71.01 to 73.00	6.5	4.70
73.01 to 75.00	7.0	5.20
75.01 to 77.00	7.5	5.70
77.01 to 79.00	8.0	6.25
79.01 to 81.00	8.5	6.80
81.01 to 83.00	9.0	7.40
83.01 to 85.00	9.5	8.00
85.01 to 87.00	10.0	8.60
87.01 to 89.00	10.5	9.25
89.01 to 91.00	11.0	9.90
91.01 to 93.00	11.5	10.60
93.01 to 95.00	12.0	11.30
95.01 to 97.00	12.5	12.00
97.01 to 99.00	13.0	12.75
99.01 to 101.00	13.5	13.50
101.01 to 103.00	14.0	14.30
103.01 to 105.00	14.5	15.10
105.01 and greater	15.0	

APPENDIX III-10

ESTIMATE OF NUMBER OF PEOPLE EMPLOYED BY FOREST
COMPANIES ON PROJECT AREA

APPENDIX III-10

ESTIMATE OF NUMBER OF PEOPLE EMPLOYED BY FOREST COMPANIES ON PROJECT AREA

The estimate is based on information supplied by Operators and comparisons with operations in other parts of Canada.

Road Construction: Where access is available, roads can be constructed all year in some areas. Construction is curtailed by snow and frozen ground, December 1 to March 31, and by wet ground from March 31 to July 1. The season can vary from 100 to 220 days and averages 160 days.

Falling and skidding operations can work all year where roads will support bus or pickup traffic. Where roads are impassable after break-up, work may be restricted to 100 days a year.

Loading and hauling can be operated double-shift 240 days a year where roads are constructed to hold the weight of logging trucks, and only 100 days if frozen ground is necessary to hold the weight of logging trucks.

Scarification - Cut-over land can be scarified six months a year.

Planting - Trees can be planted three months a year.

The attached table is based on salaried personnel working 220 days a year. This shows the minimum number required to cut this volume without working over 8 hours per day (except for truck drivers 10 hours per day) and five days per week. In actual practice the crew in winter may be above the number shown on the table, and the crew in spring and summer less than shown on the table.

APP-III-10/2

ESTIMATED NUMBER OF PEOPLE EMPLOYED IN WOODS OPERATIONS AND IN MAINTENANCE OF EQUIPMENT FOR PROJECT AREA BASED ON A 220 DAY WORK YEAR FOR SALARIED PERSONNEL AND A 200-220 DAY WORK YEAR FOR PRODUCTION WORKERS INCLUDING CONTRACTORS CREWS

CLASSIFICATION	NORTH WESTERN PULP & POWER LTD.	NORTH CANADIAN FOREST INDUSTRIES	PROCTER & GAMBLE LTD.	SMALL SAWMILL OPERATORS	TOTAL
MANAGERS, SUPERINTENDENTS & FOREMEN	19	12	12	5	48
FORESTRY & ENGINEERING	18	6	10	3	37
ACCOUNTING & OFFICE SERVICES	8	4	4	5	21
PERSONNEL & FIRST-AID	4	5	4	-	13
SCALERS	24	3	3	5	35
COOKHOUSE	-	25	4	2	31
EQUIPMENT REPAIR & MAINTENANCE	23	16	16	5	60
ROAD CONSTRUCTION & MAINTENANCE					
EQUIPMENT OPERATORS	23	20	25	5	73
- GENERAL LABOUR	4	3	3	2	12
POWER SAW OPERATORS	100	47	52	16	215
HARVESTING MACHINES		1	10		11
SKIDDER OPERATORS	100	48	61	14	223
LOG. LOADER OPERATORS	10	8	10	5	33
TRUCK DRIVERS	55	54	44	17	170
TRACTOR OPERATORS - SCARIFICATION	3	3	3	1	10
FOREST PROTECTION	3	2	3	1	9
TREE PLANTERS	15	5	15	7	42
TOTAL	409	262	279	93	1,043
PRODUCTION - CUNITS	323,000	200,000	200,000	68,000	791,000
AREA LOGGED - ACRES	12,600	11,200	10,000	3,000	36,800



APPENDIX III-11

BASIS OF 1973 HARVESTING COST ESTIMATES

APPENDIX III-11

BASIS OF 1973 HARVESTING COST ESTIMATES

The attached logging cost estimates cover the cost from the forest to logs unloaded in the mill yards. Cost information was supplied by operators, the Forest Service and people familiar with similar operations in other parts of Canada.

Unit costs are expressed in Cunits (100 cubic feet) and conversion factors used to change cords and f.b.m. to cunits are:

1 cord = 85 cubic feet
1,000 f.b.m. = 189 cubic feet
(source page 3 Timber Management Regulations)

Where possible the 1973 allowable cut was used as the volume cut as follows:

NWP & P. Ltd. - 323,000 cunits
NCFI Ltd., FMA - 95,000 cunits
NCFI Ltd. licenses - 105,000 cunits (1972 approximate cut)

Five smaller sawmill operators - 68,000 cunits
Procter & Gamble Ltd. have an allowable cut of 463,000 cunits. As their pulp mill will not be in production until late 1973, 200,000 cunits were used as the 1973 production. The total production shown for 1973 is 791,000 cunits.

Road write-off costs were calculated by considering: What part of the unamortized cost of roads constructed before 1973 should be charged to 1973 costs. Also what part of 1973 road construction costs should be charged to 1973 cost with the balance to be charged out in future years.

Phase costs such as skidding, loading and trucking costs include the cost of:

Wages and payroll loading for WCB, UI, etc.
Equipment operating, maintenance and depreciation cost.
Where a contractor supplies men and equipment for road construction, skidding, loading, trucking or any other phase, an allowance is added to the cost estimate to cover interest or profit on the contractor's investment.

Scaling includes scaling for Forest Service returns and for payment of piece workers.

Forest protection includes wages and supplies for slash burning, suppressing operational fires, disease and insect control.

Scarification includes the cost of operating tractors for this work.

Planting includes the cost of labor but excludes the cost of growing seedlings which is paid by the Alberta Forest Service.

Administration covers the cost of: Salaries of supervisors, foresters engineers, accountants, purchasing department, personnel department, and office staff. Depreciation on office buildings, shops, office equipment supplies. Insurance, legal fees, audit, telephone, telegraph, radio. Cookhouse loss including depreciation on camps, Head Office cost, and land rentals.

Stumpage is based on \$18 per M f.b.m. for sawlogs and rates shown in FMA agreements for pulpwood.

Procter & Gamble Ltd. plan to fall and skid part of their production with mobile "Harvesters" and grapple skidders working double shift.

No reliable information was available on the cost of the Harvester-Grapple skidder method so the estimated cost of falling by power saw and skidding with cable skidders on a single shift basis was used.

Eight percent interest on investment includes the interest on company investment in unamortized roads, equipment, buildings, land, supplies and woods inventories.

SUMMARY SHEET

ESTIMATED COST OF WOOD DELIVERED TO MILLS BY
F.M.A. HOLDERS AND QUOTA HOLDERS ON PROJECT AREA
VOLUMES IN CUNITS - COSTS IN THOUSANDS OF DOLLARS
- COST PER CUNIT IN DOLLARS

ITEM	QUANTITY	N.W.P. & P.		N.C.F.I.		P. & G.		SMALL OPERATORS		TOTAL COST	COST PER CUNIT
		COST	COST PER CUNIT	COST	COST PER CUNIT	COST	COST PER CUNIT	COST	COST PER CUNIT		
ROAD WRITE-OFF	791 M cunits	937	2.90	749	3.75	372	1.86	163	2.40	2,221	2.81
ROAD MAINTENANCE	"	90	.28	90	.45	100	.50	41	.60	321	.40
FALLING & LIMBING	"	1,296	4.01	690	3.45	800	4.00	238	3.50	3,024	3.82
SKIDDING	"	2,600	8.05	1,358	6.79	1,600	8.00	476	7.00	6,034	7.63
LOADING	"	260	.80	211	1.05	238	1.19	102	1.50	811	1.03
TRUCKING	"	1,900	5.88	1,720	8.60	1,422	7.11	408	6.00	5,450	6.90
CREW TRANSPORTATION	"	96	.30	56	.28	69	.35	50	.73	271	.35
SCALING	"	272	.84	20	.10	30	.15	20	.30	342	.42
UNLOAD AT MILL	"	78	.24	45	.22	60	.30	34	.50	217	.27
FOREST PROTECTION	"	50	.15	26	.13	50	.25	14	.20	140	.18
SCARIFICATION	30,000 acres	175	.54	157	.79	175	.87	17	.25	524	.66
PLANTING	8,300 acres	132	.41	44	.22	132	.66	59	.87	367	.46
ADMINISTRATION	791 M cunits	969	3.00	857	4.28	549	2.75	204	3.00	2,579	3.26
SAWLOG STUMPAGE	357 M cunits										
PULPLOG STUMPAGE	434 M cunits										
TOTAL STUMPAGE	791 M cunits	999	3.09	1,900	9.50	393	1.97	646	9.50	3,938	4.98
8% INTEREST ON WOODS INVESTMENT		280	.88	269	1.35	489	2.44	62	.91	1,100	1.39
TOTAL COST M DOLLARS	791 M cunits	10,134	31.37	8,192	40.96	6,479	32.40	2,534	37.26	27,339	34.56
PRODUCTION - CUNITS	791 M cunits	323,000		200,000		200,000		68,000			
AREA LOGGED-ACRES	36,800	12,600		11,200		10,000		3,000			
AREA SCARIFIED-ACRES	30,000	10,000		9,000		10,000		1,000			
AREA PLANTED-ACRES	8,300	3,000		1,000		3,000		1,300			



PROJECT AREA

ESTIMATED LOGGING COST FOR WOOD DELIVERED TO MILL
 - 1973 FROM F.M.A. - NORTH WESTERN PULP & POWER LTD.
 ON ALLOWABLE CUT 323,000 CUNITS

ITEM	QUANTITY	SUB TOTAL THOUSANDS OF DOLLARS	COST THOUSANDS OF DOLLARS	COST PER CUNIT DOLLARS
ROAD WRITE-OFF	323 M cunits		937	\$ 2.90
ROAD MAINTENANCE	"		90	.28
FALLING & LIMBING	"		1,296	4.01
SKIDDING	"		2,600	8.05
LOADING	"		260	.80
TRUCKING	"		1,900	5.88
CREW TRANSPORTATION	"		96	.30
SCALING	"		272	.84
UNLOAD AT MILL	"		78	.24
FOREST PROTECTION	"		50	.15
SCARIFICATION	10,000 acres		175	.54
PLANTING	3,000 acres		132	.41
<u>ADMINISTRATION</u>				
SALARIES		552		
TAXES, RENTALS F.M.A.	3,000 sq. miles	48		
SUPPLIES, DEPRECIATION TELEPHONE, RADIO, PURCHASING, SERVICES		369		
TOTAL ADMINISTRATION	323 M cunits		969	3.00
SAWLOG STUMPAGE	39,150 M = 74 M cunits @ 9.50	705		
PULPLOG STUMPAGE	249 M " @ 1.18	294		
TOTAL STUMPAGE	323 M cunits		999	3.09
8% INTEREST ON WOODS INVESTMENT			280	.88
TOTAL	323 M cunits		\$10,134	\$31.37



PROJECT AREA

ESTIMATED LOGGING COST FOR WOOD DELIVERED TO MILLS IN 1973
 FROM F.M.A. & LICENCES - NORTH CANADIAN FOREST INDUSTRIES LTD.
 F.M.A. 95,000 CUNITS - LICENCES 105,000 - TOTAL 200,000 CUNITS

ITEM	QUANTITY	SUB TOTAL THOUSANDS OF DOLLARS	COST THOUSANDS OF DOLLARS	COST PER CUNIT DOLLAR
ROAD WRITE-OFF	200 M cunits		749	\$ 3.7
ROAD MAINTENANCE	"		90	.4
FALLING & LIMBING	"		690	3.4
SKIDDING	"		1,358	6.7
LOADING	"		211	1.0
TRUCKING	"		1,720	8.6
CREW TRANSPORTATION	"		56	.2
SCALING	"		20	.1
UNLOAD AT MILL	"		45	.2
FOREST PROTECTION	"		26	.1
SCARIFICATION	9,000 acres		157	.7
PLANTING	1,000 acres		44	.2
<u>ADMINISTRATION</u>				
SALARIES		400		
TAXES, RENTALS		30		
COOKHOUSE LOSS		227		
DEPRECIATION, SUPPLIES		200		
TELEPHONE RADIO SERVICES				
TOTAL ADMINISTRATION	200 M cunits		857	4.2
SAWLOG STUMPAGE	106,000 M f.b.m. (200 M cunits) @ 9.50		1,900	9.5
PULPLOG STUMPAGE	-		-	-
8% INTEREST ON WOODS INVESTMENT			269	1.3
TOTAL	200 M cunits		8,192	\$40.9



SCHULCO

PROJECT AREA

ESTIMATED LOGGING COST FOR WOOD DELIVERED TO
PROCTER & GAMBLE COMPANY LIMITED MILL IN 1973 FROM F.M.A.
ESTIMATED PRODUCTION 200,000 CUNITS

ITEM	QUANTITY	SUB TOTAL THOUSANDS OF DOLLARS	COST THOUSANDS OF DOLLARS	COST PER CUNIT DOLLARS
ROAD WRITE-OFF	200 M cunits		372	\$ 1.86
ROAD MAINTENANCE	"		100	.50
FALLING & LIMBING	"		800	4.00
SKIDDING	"		1,600	8.00
LOADING	"		238	1.19
TRUCKING	"		1,422	7.11
CREW TRANSPORTATION	"		69	.35
SCALING	"		30	.15
UNLOAD AT MILL	"		60	.30
FOREST PROTECTION	"		50	.25
SCARIFICATION	10,000 acres		175	.87
PLANTING	3,000 acres		132	.66
<u>ADMINISTRATION</u>				
SALARIES		330		
TAXES RENTALS F.M.A.		85		
COOKHOUSE LOSS		34		
DEPRECIATION, SUPPLIES		100		
SERVICES				
TELEPHONE RADIO				
TOTAL ADMINISTRATION	200 M cunits		549	2.75
SAWLOG STUMPAGE	15 M cunits @ 9.50	143		
PULPLOG STUMPAGE	185 M cunits @ 1.35	250		
TOTAL STUMPAGE			393	1.97
8% INTEREST ON WOODS INVESTMENT			489	2.44
TOTAL	200 M cunits		6,479	\$32.40



PROJECT AREA

ESTIMATED LOGGING COST FOR SMALL OPERATORS
 BASED ON LOGS DELIVERED TO SAWMILLS - 1973
 ESTIMATED 1973 PRODUCTION 68,000 CUNITS

ITEM	QUANTITY	SUB TOTAL THOUSANDS OF DOLLARS	COST THOUSANDS OF DOLLARS	COST PER CUNIT DOLLARS
ROAD WRITE-OFF	68 M cunits		163	\$ 2.40
ROAD MAINTENANCE	"		41	.60
FALLING & LIMBING	"		238	3.50
SKIDDING	"		476	7.00
LOADING	"		102	1.50
TRUCKING	"		408	6.00
CREW TRANSPORTATION	"		50	.73
SCALING	"		20	.30
UNLOAD AT MILL	"		34	.50
FOREST PROTECTION	"		14	.20
SCARIFICATION	1,000 acres		17	.25
PLANTING	1,300 acres		59	.87
<u>ADMINISTRATION</u>				
SALARIES				
TAXES RENTALS				
COOKHOUSE LOSS				
DEPRECIATION				
SERVICES				
TOTAL ADMINISTRATION	68 M cunits		204	3.00
SAWLOG STUMPAGE	68 M cunits @ 9.50		646	9.50
PULPLOG STUMPAGE				
8% INTEREST ON WOODS INVESTMENT			62	.91
TOTAL	68 M cunits		2,534	\$37.26



APPENDIX III-12

BASIS FOR MODEL TO ESTIMATE UNAMORTIZED ROAD COSTS
FOR DIFFERENT CUTTING SYSTEMS

APPENDIX III-12

BASIS FOR MODEL TO ESTIMATE UNAMORTIZED ROAD COSTS FOR DIFFERENT CUTTING SYSTEMS

1. The four cases for analysis are:

Case *	Cycle (years)	Cutover (acres)	First Cut (years)	Second Cut (years)
SN	20	40	1-10	11-20
SB	20	240	1-10	11-20
LN	30	40	1-10	21-30
LB	30	240	1-10	21-30

*S - Short cycle

N - Narrow strips

L - Long cycle

B - Blocks

2. The annual cut in each of the four cases is 300,000 cunits, taken from 16,000 acres. Cases SN and SB require continuous cutting of a 320,000-acre tract over 20 years. Cases LN and LB require intermittent cutting of two such tracts, one being operated in years 1-10 and 21-30, and the other being operated in years 11-20 and 31-40. The cycle for each 320,000-acre tract is thus 30 years long, within a 40-year combined cycle.
3. ROADS: Assume the area is flat or rolling and can be developed by one mile of road for each 100 acres cut as follows:
- a) Main roads developing 5,300 acres per mile
cost - \$27,000 per mile.
 - b) Branch roads developing 640 acres per mile
cost - \$16,000 per mile.

- c) Spur roads developing 121 acres per mile of road cost - \$4,500 per mile based on 50% winter road at \$3,000 per mile and 50% summer road at \$6,000 per mile.

4. Case SN (Short cycle, narrow strips)

Sketch "A" attached shows how this cutting method could be applied to a four-square mile (2,560-acre operation) on flat ground. The main road is on one side of the area, branch roads one mile apart. Forty-acre strips, 660' x 2,640', are staggered at right angles to these. Spur roads run from the branch road through the center of the 40-acre strips.

ROAD MILEAGE REQUIRED TO DEVELOP THIS 2,560-ACRE BLOCK IS:

Main Road	0.5 miles
Branch Road	4.0 miles
Spur Road	21.1 miles

Road requirements for a cut of 16,000 acres per year include an allowance for roads through or around immature stands and non-productive land.

Roads required to cut 16,000 acres a year over the 20-year cycle are:

	ROADS REQUIRED TO START OPERATION FIRST YEAR	ROADS REQUIRED PER YEAR 2ND TO 11TH YEAR	ROADS REQUIRED PER YEAR 11TH TO 21ST YEAR
Main Road	6 miles	6 miles	none
Branch Road	50 miles	50 miles	none
Spur Road	132 miles	132 miles	132 miles
TOTAL	188 miles	188 miles	132 miles

Table SN traces the annual cost of road constuction, costs of roads logged off and the unamortized cost of roads for logging 320,000 acres in 20 years. The unamortized cost of roads starts at \$2,037 M at the end of year 2, increases to \$6,366 M at

year 11, the end of the first cut, then gradually drops to \$2,037 M in year 20, near the end of the residual cut.

The mileage of road requiring annual maintenance starts at 100 miles, increases to 430 miles (year 11) then drops to 160 miles.



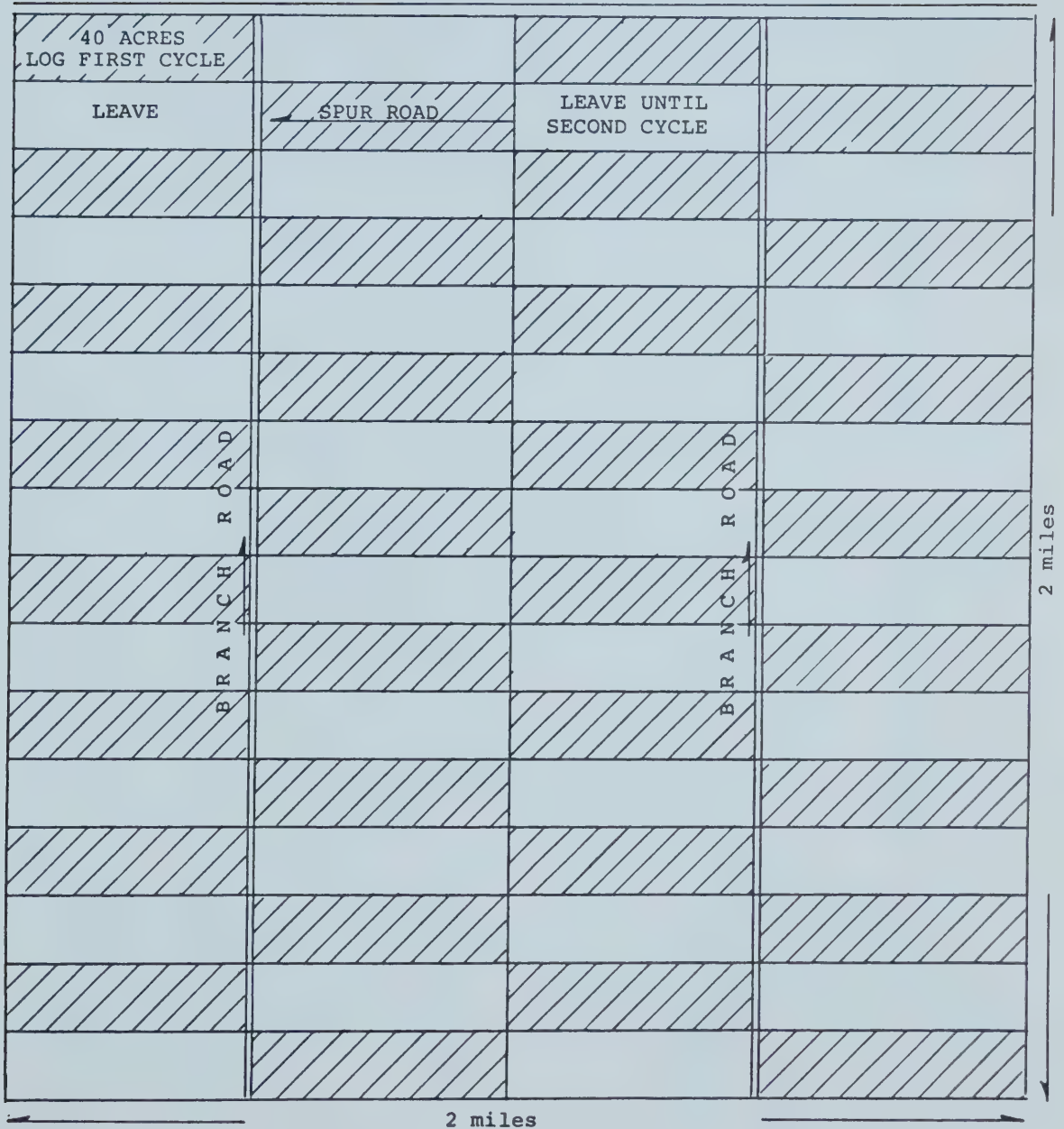
SKETCH A

(CASE N)

MODEL FOR 50% CUT-40 ACRE BLOCKS

SCALE 1" = 1/4 MILE

MAIN ROAD



SCHULCO

APPENDIX III-12

TABLE SN

MODEL SHOWING UNAMORTIZED ROAD COST FOR A LOGGING OPERATION CUTTING 300,000 CUNITS PER YEAR FROM 16,000 ACRES - 50 PERCENT FIRST CUT - 50 PERCENT SECOND CUT - in 40-ACRE BLOCKS UNCLUT AREAS TO BE LEFT 10 YEARS TO REGENERATE THEN CUT YEAR 11 TO 21

COST IN THOUSANDS OF 1973 DOLLARS

YEAR LOGGED	MILES OF ROAD TO MAINTAIN	COMMENT	ROAD CONSTRUCTION PROGRAM					DEDUCT COST OF ROADS LOGGED					UNAMORTIZED COST OF ROADS															
			MILES	MAIN ROADS COST	MILES	BRANCH ROADS COST	MILES	SPUR ROADS COST	TOTAL COST	MILES	MAIN ROADS	MILES	BRANCH ROADS	MILES	SPUR ROADS	TOTAL	MILES	MAIN ROADS	MILES	BRANCH ROADS	MILES	SPUR ROADS	TOTAL					
1	100	START CONSTRUCTION ONE YEAR AHEAD OF LOGGING	6	162	50	800	132	594	188	1,556			6	162	50	800	132	594	188	1,556								
2	160		LOG 16,000 ACRES	6	162	50	800	132	594	188	1,556	3	81	25	400		132	594	160	1,075	9	243	75	1,200	132	594	216	2,037
3	200		"	6	162	50	800	132	594	188	1,556	3	81	25	400		132	594	160	1,075	12	324	100	1,600	132	594	244	2,518
4	230		"	6	162	50	800	132	594	188	1,556	3	81	25	400		132	594	160	1,075	15	405	125	2,000	132	594	272	2,999
5	270		"	6	162	50	900	132	594	188	1,556	3	81	25	400		132	594	160	1,075	18	486	150	2,400	132	594	300	3,480
6	300		"	6	162	50	800	132	594	188	1,556	3	81	25	400		132	594	160	1,075	21	567	175	2,800	132	594	328	3,961
7	320	START TO CUT 16,000 ACRES FROM UNCLUT 40 AC. BLOCKS	6	162	50	800	132	594	188	1,556	3	81	25	400		132	594	160	1,075	24	648	200	3,200	132	594	356	4,442	
8	350		LOG 16,000 ACRES	6	162	50	800	132	594	188	1,556	3	81	25	400		132	594	160	1,075	27	729	225	3,600	132	594	384	4,923
9	380		"	6	162	50	800	132	594	188	1,556	3	81	25	400		132	594	160	1,075	30	810	250	4,000	132	594	412	5,404
10	410		"	6	162	50	800	132	594	188	1,556	3	81	25	400		132	594	160	1,075	33	891	275	4,400	132	594	440	5,885
11	430		"	6	162	50	800	132	594	188	1,556	3	81	25	400		132	594	160	1,075	36	972	300	4,800	132	594	468	6,366
12	410		START TO CUT 16,000 ACRES FROM UNCLUT 40 AC. BLOCKS					132	594	132	594	3	81	25	400		132	594	160	1,075	33	891	275	4,400	132	594	440	5,885
13	380	"						132	594	132	594	3	81	25	400		132	594	160	1,075	30	810	250	4,000	132	594	412	5,404
14	350	"						132	594	132	594	3	81	25	400		132	594	160	1,075	27	729	225	3,600	132	594	384	4,923
15	320	"						132	594	132	594	3	81	25	400		132	594	160	1,075	24	648	200	3,200	132	594	356	4,442
16	300	"						132	594	132	594	3	81	25	400		132	594	160	1,075	21	567	175	2,800	132	594	328	3,961
17	270	"						132	594	132	594	3	81	25	400		132	594	160	1,075	18	486	150	2,400	132	594	300	3,480
18	230	OPEN NEW LOGGING AREA					132	594	132	594	3	81	25	400		132	594	160	1,075	15	405	125	2,000	132	594	272	2,999	
19	200		"					132	594	132	594	3	81	25	400		132	594	160	1,075	12	324	100	1,600	132	594	244	2,518
20	160		"					132	594	132	594	3	81	25	400		132	594	160	1,075	9	243	75	1,200	132	594	216	2,037
21	190		"	6	162	50	800	132	594	188	1,556	3	81	25	400		132	594	160	1,075	12	324	100	1,600	132	594	244	2,516

5. Case SB (Short cycle, 240-acre blocks)

Sketch "B" attached shows how a 2-mile x 4-1/8 mile (5,280-acre) area could be developed by a main road, branch roads one mile apart and how the blocks can be arranged to give the least timber edge exposed to winds. Spur roads are not shown but would be constructed at right angles to branch roads.

ROAD MILEAGE REQUIRED TO DEVELOP THIS 5,280-ACRE BLOCK IS:

	FIRST CUT	SECOND CUT
Main Road	1.0 miles	---
Branch Road	6.6 miles	1.6 miles
Spur Road	43.6 miles	43.6 miles

Roads required to cut 16,000 acres for 10 years in 240-acre blocks and 16,000 acres a year of residual 240-acre blocks are:

	ROADS REQUIRED TO START LOGGING FIRST YEAR	ROADS REQUIRED PER YEAR 2ND TO 10TH YEAR	ROADS REQUIRED PER YEAR 11TH TO 21ST YEAR
Main Road	6 miles	6 miles	none
Branch Road	50 miles	40 miles	10 miles
Spur Road	132 miles	132 miles	132 miles
TOTAL	188 miles	178 miles	142 miles

Table SB traces the annual cost of road construction, cost of roads logged off and the unamortized cost of roads for logging 320,000 acres in 20 years. The unamortized cost of roads starts at \$1,877 M at the end of year 2, increases to \$4,766 M at the end of the eleventh year, the end of the first cut, then gradually drops to \$1,877 M at year 20 near the end of the residual cut.

The mileage of road requiring road maintenance starts at 100 miles, increases to 330 miles at year 11, then drops to 160 miles at year 20 near the end of the residual cut.





M.MULLO

APPENDIX III-12

TABLE SB

MODEL SHOWING UNAMORTIZED ROAD COST FOR A LOGGING OPERATION CUTTING 300,000 UNITS PER YEAR IN 240-ACRE BLOCKS,
16,000 ACRES PER YEAR IN FIRST CUT - 16,000 ACRES PER YEAR CUT IN RESIDUAL BLOCKS. STARTING 10 YEARS AFTER FIRST CUT

COST IN THOUSANDS OF 1973 DOLLARS

YEAR LOGGED	MILES OF ROAD TO MAINTAIN	COMMENT	ROAD CONSTRUCTION PROGRAM						DEDUCT COST OF ROADS LOGGED						UNAMORTIZED COST OF ROADS											
			MAIN ROADS COST	MILES	BRANCH ROADS COST	MILES	SPUR ROADS COST	MILES	TOTAL COST	MILES	MAIN ROADS	MILES	BRANCH ROADS	MILES	SPUR ROADS	MILES	TOTAL	MILES	MAIN ROADS	MILES	BRANCH ROADS	MILES	SPUR ROADS	MILES	TOTAL	
1	100	START CONSTRUCTION ONE YEAR AHEAD OF LOGGING LOG 16,000 ACRES	6	162	50	800	132	594	188	1,556							6	162	50	800	132	594	188	1,556		
2	160		6	162	40	640	132	594	178	1,396	3	81	25	400	132	594	160	1,075	9	243	65	1,040	132	594	206	1,877
3	180		6	162	40	640	132	594	178	1,396	3	81	25	400	132	594	160	1,075	12	324	80	1,280	132	594	224	2,198
4	200		6	162	40	640	132	594	178	1,396	3	81	25	400	132	594	160	1,075	15	405	95	1,520	132	594	242	2,519
5	220		6	162	40	640	132	594	178	1,396	3	81	25	400	132	594	160	1,075	18	486	110	1,760	132	594	260	2,840
6	240		6	162	40	640	132	594	178	1,396	3	81	25	400	132	594	160	1,075	21	567	125	2,000	132	594	278	3,161
7	260		6	162	40	640	132	594	178	1,396	3	81	25	400	132	594	160	1,075	24	648	140	2,240	132	594	296	3,482
8	270		6	162	40	640	132	594	178	1,396	3	81	25	400	132	594	160	1,075	27	729	155	2,480	132	594	314	3,803
9	290		6	162	40	640	132	594	178	1,396	3	81	25	400	132	594	160	1,075	30	810	170	2,720	132	594	332	4,124
10	310		6	162	40	640	132	594	178	1,396	3	81	25	400	132	594	160	1,075	33	891	185	2,960	132	594	350	4,445
11	330		6	162	40	640	132	594	178	1,396	3	81	25	400	132	594	160	1,075	36	962	200	3,200	132	594	368	4,766
12	310	CUT 16,000 ACRES FROM RESIDUAL-240 ACRE BLOCKS			10	160	132	594	142	754	3	81	25	400	132	594	160	1,075	33	891	185	2,960	132	594	350	4,445
13	290				10	160	132	594	142	754	3	81	25	400	132	594	160	1,075	30	810	170	2,720	132	594	332	4,124
14	270				10	160	132	594	142	754	3	81	25	400	132	594	160	1,075	27	729	155	2,480	132	594	314	3,803
15	260				10	160	132	594	142	754	3	81	25	400	132	594	160	1,075	24	648	140	2,240	132	594	296	3,482
16	240				10	160	132	594	142	754	3	81	25	400	132	594	160	1,075	21	567	125	2,000	132	594	278	3,161
17	220				10	160	132	594	142	754	3	81	25	400	132	594	160	1,075	18	486	110	1,760	132	594	260	2,840
18	200				10	160	132	594	142	754	3	81	25	400	132	594	160	1,075	15	405	95	1,520	132	594	242	2,519
19	180				10	160	132	594	142	754	3	81	25	400	132	594	160	1,075	12	324	80	1,280	132	594	224	2,198
20	160				10	160	132	594	142	754	3	81	25	400	132	594	160	1,075	9	243	65	1,040	132	594	206	1,877
21	190		OPEN NEW LOGGING AREA	6	162	50	800	132	594	188	1,556	3	81	25	400	132	594	160	1,075	12	324	90	1,440	132	594	234

6. Effect of Block or Strip Size

The information in Tables SN and SB is condensed and compared below to show the financial effect of cutting with 40-acre strips and with 240-acre blocks.

CASE SNCASE SB

YEAR SHOWN ON TABLES SN, SB	40-ACRE STRIPS			240-ACRE BLOCKS		
	MILES OF ROAD TO MAINTAIN	COST OF UNAMORT- IZED ROADS M DOLLARS	COST OF INTEREST PER CUNIT LOGGED DOLLARS	MILES OF ROAD TO MAINTAIN	COST OF UNAMORT- IZED ROADS M DOLLARS	COST OF INTEREST PER CUNIT LOGGED DOLLARS
2	160	2,037	0.54	160	1,877	0.50
5	270	3,480	0.93	220	2,840	0.76
8	350	4,923	1.31	270	3,803	1.01
11	430	6,366	1.69	330	4,766	1.27
14	350	4,923	1.31	270	3,803	1.01
17	270	3,480	0.93	220	2,840	0.76
20	160	2,037	0.54	160	1,877	0.50
AVERAGE			1.04			0.83

This shows interest cost per cunit logged on a production of 300,000 cunits per year. It is less if the 240-acre block system is used. This is based on 8 percent. If higher rates of interest are used the difference is more significant. Less road maintenance is required under the 240-acre block system than under the 40-acre strip system. The only cost that may be higher for the 240-acre block system is the estimated cost of planting spruce areas.



7. Case LN (long cycle, narrow strips)Case LB (long cycle, 240-acre blocks)

These two cases employing the longer cycle entail the same cutting systems used in Cases SN and SB respectively, but intermittent development of two 320,000-acre tracts at once, over a 40-year term. Projections from Tables SN and SB, incorporating this change, are summarized below. Road maintenance and amortization costs are naturally higher since more time elapses before completion of all cutting.

The following table is similar to the table in 6 above.

CASE LNCASE LB

YEAR	LOGGED 40-ACRE BLOCKS			LOGGED 240-ACRE BLOCKS		
	MILES OF ROAD TO MAINTAIN	COST OF UNAMORTIZED ROADS M DOLLARS	COST OF INTEREST PER CUNIT LOGGED DOLLARS	MILES OF ROAD TO MAINTAIN	COST OF UNAMORTIZED ROADS M DOLLARS	COST OF INTEREST PER CUNIT LOGGED DOLLARS
2	160	2,037	0.54	160	1,877	0.50
5	270	3,480	0.93	220	2,840	0.76
11	430	6,366	1.70	330	4,766	1.27
15	540	8,290	2.21	400	6,050	1.61
21	710	11,176	2.98	510	7,976	2.13
25	600	9,252	2.47	440	6,692	1.78
30	460	6,847	1.83	350	5,087	1.36
35	320	4,442	1.18	260	3,482	0.93
40	170	2,037	0.54	170	1,877	0.50
AVERAGE			1.60	1.20		



This estimate does not include extra cost of maintaining a longer road system and the effect of possible longer truck hauls in the first 20 years because timber close to the mills is tied up in "Leave Blocks".

APPENDIX III-13

EXCERPT FROM TIMBER MANAGEMENT
REGULATIONS (1973) PERTAINING
TO RESTOCKING STANDARDS

APPENDIX III-13

EXCERPT FROM TIMBER MANAGEMENT REGULATIONS (1973) PERTAINING TO RESTOCKING STANDARDS

131. A licensee shall show in his annual operating plan his proposed reforestation program.
132. Considering the year of cut as being the first year, a licensee or holder of a forest management agreement shall complete and submit to the Minister a reforestation survey which meets the specifications of the Minister by the end of the seventh year for all areas he is obliged to reforest.
133. The Minister may establish qualifications and require any person undertaking a reforestation survey for submission to the Minister to meet them.
134. Considering the year of cut as being the first year and if, by the end of the seventh year, the Minister decides that the new growth of tree seedlings is below the required standard, the licensee or holder of a forest management agreement shall carry out within the following year all the operations necessary to reforest to the required standard by the end of the tenth year.
135. For the purpose of determining whether or not an area is reforested to the required standard, it shall be considered to be sub-divided into units or one-thousandth of an acre, called milacres.
136. The Minister may determine the boundaries of any area to be considered as a unit for the purpose of establishing whether or not it is reforested.

(Source: AFS)



137. In order for any area to be classified as reforested in accordance with the required standard
- (a) 40 percent of the milacres it includes must contain an established seedling tree;
 - (b) three-quarters or more of the established seedling trees must be spruce, pine or douglas fir, and the other one-quarter or less must be balsam fir, birch or poplar seedling trees;
 - (c) it cannot contain any areas larger than 10 acres in extent which do not in themselves meet the required stocking standard, and,
 - (d) identifiable areas larger than three acres which in themselves do not meet the required stocking standard must not in the aggregate exceed 20 percent of the total area to be classified.
138. (1) For the purpose of these regulations the term "established seedling tree" means
- (a) a live and healthy seedling tree which has grown in its present location at least three years, or
 - (b) a sound, undamaged spruce, pine or douglas fir tree under 30 years of age and in its original natural location which will probably be live and merchantable when the rest of the established seedling trees on the area are logged.
- (2) Two live healthy seedling trees that have grown on the same milacre for two years are acceptable in substitution for an established seedling tree.
139. Where a licensee fails to reforest any area he is obliged to reforest to the required standard by the end of the tenth year, the Minister may suspend all operations under authority of the quota under which the license was issued until the quota holder has complied with any direction received from the Minister in relation to the reforestation of the area.

(Source: AFS)

140. The expiration or termination of a person's license or the lapse of time does not relieve the person of his reforestation obligation pursuant to these regulations.
141. Seed or seedling trees for reforestation purposes may be obtained by a licensee from the Minister in exchange for a sufficient supply of seed producing cones to supply the seed or grow the seedlings.
142. Seedling trees may be purchased from the Minister by a licensee, if they are available, upon payment of the total cost of producing and handling the seedling trees.
143. The Minister may establish rules governing the source and type of tree seed used to forest public lands.
144. A request for conventional seedling trees shall be made three years before the required delivery date thereof and for plug or container type of seedling trees one year before the required delivery date thereof.
145. When in the Minister's opinion seedling trees supplied in exchange for the seed producing cones were negligently wasted the recipient thereof upon request shall pay to the Minister the balance of the actual cost of supplying the seedlings.

(Source: AFS)

APPENDICES

CHAPTER V

APPENDIX V-1

BIBLIOGRAPHY

APPENDIX V-1

BIBLIOGRAPHY

Surficial Geology

Soils

Climate and Hydrology

Wildlife

Fish

Regional History

Roads and Harvesting

Silviculture

Land Use and Resource Development

Environmental Impact

SURFICIAL GEOLOGY

- Lindsay, J.D., A. Wynnyk, and W. Odymsky. 1963.
Exploratory soil survey of Alberta Map Sheets 83L, 83K, 83F, and 83J. Research Council of Alberta. Preliminary Soil Survey Report 64-2.
- Odymsky, W., A. Wynnyk, and J.D. Newton. 1956.
Soil survey of the Grande Prairie and Sturgeon Lake sheets. Research Council of Alberta, Report 74.
- Odymsky, W., J.D. Lindsay, S.W. Reeder, and A. Wynnyk. 1961.
Soil survey of the Beaverlodge and Blueberry Mountain sheets. Research Council of Alberta, Report 20.
- Roed, M.A. 1970.
Surficial geology of the Edson area. NTS 83F. Research Council of Alberta, Map 33.



SOILS

- Canada Department of Agriculture. 1970.
The system of soil classification for Canada. Queen's Printer,
Ottawa.
- Duffy, P.J.B., and Z. Nemeth. 1969.
A forest land capability classification for the East Slopes area,
Alberta. Can. For. Res. Lab. Calgary, Inf. Rep. A-X-20. 19 pp.
- Dumanski, J., and T. Macyk. In Press.
Soil survey of the Hinton-Edson area. 83F. Alberta Soil
Survey Report No. 32. (Maps published, report in press.)
- Knight, H. 1967.
Progress of the Canada Land Inventory in Alberta. Can. For. Res.
Lab. Calgary, Inf. Rep. A-X-9. 72 pp.
- Knight, H., and P.J.B. Duffy. 1967.
A forest land capability classification for the Marsh Head
Demonstration Area, Whitecourt Forest, Alberta. Can. For. Res.
Lab. Calgary, Inf. Rep. A-X-1. 20 pp.
- Lindsay, J.D., A. Wynnyk, and W. Odymsky. 1963.
Exploratory soil survey of Alberta Map Sheets 83L, 83K, 83F, and
83J. Res. Council Alberta, Prelim. Soil Survey Report 64-2.
53 pp.
- Odymsky, W., A. Wynnyk, and J.D. Newton. 1956.
Soil survey of the Grande Prairie and Sturgeon Lake sheets. Res.
Council Alberta, Report 74. 111 pp.
- Odymsky, W., J.D. Lindsay, S.W. Reeder, and A. Wynnyk. 1961.
Soil survey of the Beaverlodge and Blueberry Mountain sheets
(Appendix by A.C. Carder) Res. Council Alberta, Report 81.
123 pp.

CLIMATE AND HYDROLOGY

Alberta Forest Service, Forest Protection Branch, Edmonton.
(Unpublished climatic records.)

Atmospheric Environment Service, Calgary & Edmonton.
(Published and unpublished data.)

Buck, C.C. 1964.
Winds Over Wildlands - A Guide For Forest Management,
Agriculture Handbook No. 272, U.S.D.A. Forest Service.
U.S. Government Printing Office. 33 pp.

Klein, W.H. 1957.
Principle Tracks and Mean Frequencies of Cyclones and Anti-
cyclones in the Northern Hemisphere. U.S. Weather Bureau
Research Paper No. 40. 60 pp.

MacIver, Donald C. 1970.
Microclimatic Zonation in Northern Alberta. Master's Thesis,
Department of Geography, University of Alberta. 187 pp.

Short, P., and R. Pinel. 1972.
Project Report on Field Studies in the Cutbank Watershed.
Forest Land Use Branch, Edmonton.

Warner, L.A., and W.C. Thompson. 1972.
Preliminary Report - Peace River Basin Flood, June 1972.
Canada Department of the Environment, Inland Waters Branch -
Water Survey of Canada, Calgary.

Water Survey of Canada, Calgary.
(Published and unpublished data.)

Wyldman, E.C., and W.H. Poliquin. 1973.
Effects of Oilfield Development on Sedimentation in the Swan
Hills, Alberta. Discussion Paper presented at the 9th Canadian
Hydrology Symposium, May 8-9, 1973, at the University of Alberta,
Edmonton.



WILDLIFE

Beil, C.C. 1966.

An ecological study of the primary producer level of the subalpine spruce-fir ecosystem of Banff and Jasper National Parks, Alberta. Unpublished Ph.D. Thesis. U. of Alberta.

Burgess, T. No date.

Caribou in Northwestern Alberta. Typewritten report from a seminar of the Fish and Wildlife Division, Alberta Department of Lands and Forests.

Cahalane, V.H. 1961.

Mammals of North America. MacMillan C., N.Y.

Constan, K.J. 1972.

Winter foods and range use of three species of ungulates. J. Wildlife Man. 36(4):1068-1076.

Cormack, R.G.H. 1953.

A survey of coniferous forest succession in the eastern Rockies. Forestry Chron. 29(3):218-232.

Corns, I.G.W. 1972.

Early plant succession after clearcutting of lodgepole pine forests in the lower foothills of Alberta. Unpublished Ph.D. Thesis. U. of Alberta.

Cowan, I. McT. 1947.

Range competition between mule deer, bighorn sheep, and elk in Jasper Park, Alberta. Trans. 12th North Amer. Wildlife Conf. 223-227.

1952.

The role of wildlife on forest land in western Canada. Forestry Chron. 28(1):42-49.



WILDLIFE

Crinigan, A.T. 1957.

History, food habits and range requirements of the woodland caribou of continental North America. Trans. 22nd North Amer. Wildlife Conf. 485-500.

Edwards, R.Y., and R.W. Ritcey. 1960.

Foods of caribou in Wells Grey Park, British Columbia. Canadian Field Natur. 74:3-7.

Ellison, L. 1966.

Seasonal foods and chemical analysis of winter diet of Alaskan Spruce grouse. J. Wildlife Man. 30(4):729-735.

Gullion, G.W. 1970.

Factors influencing ruffed grouse populations. Trans. 35th North Amer. Wildlife and Nat. Res. Conf. 93-105.

Horton, K.W. 1956.

The ecology of lodgepole pine in Alberta and its role in forest succession. Canada Dept. Northern Affairs and Nat. Res., Forest Res. Div., Tech. Note No. 45.

1959.

Characteristics of subalpine spruce in Alberta. Canada Dept. Northern Affairs and Nat. Res., Forest Res. Div., Tech. Note No. 76.

Jonkel, C.J., and I. McT. Cowan. 1971.

The black bear in the spruce-fir forest. Wildlife Monogr. 27:1-57.

Leopold, A. 1933.

Game Management. Chas. Scribner's Sons, N.Y. 481 pp.

Leopold, A.S. 1950.

Deer in relation to plant succession. Trans. 15th North Amer. Wildlife Conf. 571-580.



WILDLIFE

Loveless, C.M. 1964.

Some relationships between wintering mule deer and the physical environment. Trans. 29th North Amer. Wildlife and Nat. Res. Conf. 415-431.

Lungle, K.J. 1971.

The applicability of the square mile quadrat census method for moose in the Wapiti area, 1970. Typewritten report, Alberta Dept. of Lands and Forests.

Lynch, G.M. 1971.

Ungulate population surveys conducted in the Edson region. Typewritten report, Alberta Dept. of Lands and Forests.

Marshall, W.H. 1951.

Pine marten as a forest product. J. Forestry 49(12):899-905.

Millar, J.D. 1953.

An ecological study of the moose in the Rock Lake area of Alberta. Unpublished M.Sc. Thesis. U. of Alberta.

Millar, R.J. 1971

Alberta's hunting and fishing resources - an economic evaluation. Alberta Department of Agriculture, Economics Division in co-operation with Alberta Department of Lands and Forests, Fish and Wildlife Division.

Moss, E.H. 1959.

Flora of Alberta. U. of Toronto Press. 546 pp.

Novakowski, N.W. 1965.

Population dynamics of a beaver population in northern latitudes. Unpublished Ph.D. Thesis. U. of Saskatchewan.

WILDLIFE

- Pearson, T.G., et al. (eds). 1936.
Birds of America. Garden City Books, N.W.
- Pendergast, B.A. 1969.
Nutrition of spruce grouse of the Swan Hills, Alberta.
Unpublished M.Sc. Thesis. U. of Alberta.
- Renewable Resources Consulting Services Ltd. 1971.
An ecological study of wildlife and fisheries in the Pembina
and Sturgeon River Basins. Prepared for Alberta Dept. of the
Environment.
- Rusch, D.H., and L.B. Keith. 1971.
Ruffed grouse-vegetation relationships in central Alberta.
J. Wildlife Man. 35(3):417-429.
- Salt, W.R., and A.L. Wilk. 1958.
The Birds of Alberta. Queen's Printer, Edmonton. 511 pp.
- Saunders, J.K., Jr. 1963.
Movements and activities of the lynx in Newfoundland.
J. Wildlife Man. 27(3):390-400.
- Sheppard, D.H. 1960.
The ecology of the mule deer of the Sheep River region.
Unpublished M.Sc. Thesis. U. of Alberta.
- Soper, J.D. 1947.
Observations on mammals and birds in the Rocky Mountains of
Alberta. Can Field Natur. 61(5):143-173.
- _____. 1948.
Mammal notes from the Grande Prairie - Peace River region,
Alberta. J. Mammal 29(1):49-64.

WILDLIFE

_____1949.

Birds observed in the Grande Prairie - Peace River region of
northwestern Alberta, Canada. Auk. 66(3):233-257.

_____1964.

The Mammals of Alberta. Queen's Printer, Edmonton. 402 pp.

Stelfox, J. 1963.

Elk foods and range components. Typwritten report. No source.

Stollberg, B.P., and R.L. Hine. 1952.

Food habit studies of ruffed grouse, pheasant, quail, and mink
in Wisconsin. Wisconsin Cons. Dept., Game Man. Div., Tech.
Wildlife Bulletin. No. 4.

Wishart, W.D. 1958.

The bighorn sheep of the Sheep River Valley. Unpublished M.Sc.
Thesis. U. of Alberta.



FISH

- Anonymous. 1971.
Fish passage through culverts - Special Report. Oregon State Game Commission.
- Atkinson, S.W. 1971.
BOD and toxicity of log leachates. M.S. Thesis. Oregon State University. 96 pp.
- Bormanz, F., G.E. Likens, D.W. Fisher, and R.S. Pierce. 1968.
Nutrient loss accelerated by clear cutting of a forest ecosystem. Science, 1959:882-884.
- Brett, J.R. 1964.
Oxygen consumption in young sockeye. J. Fish. Res. Bd. Can., Vol. 21.
- Brett, J.R. 1967.
Salmon. In: McGraw-Hill Yearbook of Science and Technology, Ed. D.I. Eggenberger, McGraw-Hill Book Co., No. 4. 348-349.
- Brown, G.W. 1970.
Predicting the effect of clear cutting on stream temperature. J. Soil Water Conserv. 25(1):11-13.
- Brown, G.W., G.W. Shank, and J. Rothacher. 1971.
Water temperature in the Steamboat Drainage. U.S.D.A, Forest Serv., Pac. N.W. Forest and Range Exp. Sta. Res. Paper PNW-119. 17 pp.
- Brown, G.W., and J.T. Krygier. 1970.
Effects of clear cutting on stream temperature. Water Resources Res. 6(4):1133-1139.
- Chapman, D.W. 1962.
Effects of logging upon fish resources of the west coast. Forestry 60(8):533-537.



FISH

Dietz, K. 1971.

The rainbow trout population (*Salmo gairdneri* Richardson) and other fish of three streams in the foothills of Alberta.

M.Sc. Thesis, Dept. of Zoology, U. of Alberta. 71 pp.

Dryness, C.T. 1970.

Stabilization of newly constructed road backslopes by mulch and grass-legume treatments. U.S.D.A. Forest Serv., Pac. N.W. Forest and Range Exp. Sta., Res. Note PNW-123. 5 pp.

Eschner, A.R., and J. Larmoyeux. 1963.

Logging and trout: four experimental forest practices and their effect on water quality. Prog. Fish-Cult. 25(2):59-67.

Fredrickson, R.L. 1970.

Erosion and sedimentation following road construction and timber harvest on unstable soils in three small western Oregon watersheds. U.S.D.A. Forest Serv., Pac. N.W. Forest and Range Exp. Sta., Res. Paper PNW-104. 15 pp.

Fredrickson, R.L. 1971.

Comparative chemical water quality - natural and disturbed streams following logging and slash burning. In: Proc. Sym. Forest Land Uses and Stream Environment, Oct. 19-21, 1970. Oregon State Univ. 125-137.

Gibson, H.R., and D.W. Chapman. 1972.

Zectran insecticide on aquatic organisms in Bear Valley Creek, Idaho. Trans. Amer. Fish Society 101(2):330-334.

Graham, J.L. 1970.

Pollutants leached from selected species of wood in log storage waters. M.S. Thesis, Oregon State Univ.

Helmers, A.E. 1966.

Some effects of log jams and flooding in a salmon spawning stream. U.S.D.A. Forest Serv. Northern Forest Expt. Sta. Res. Note NOR-14. 4 pp.

FISH

- Hibbert, A.R. 1967.
Forest treatment effects on water yield. In: W.E. Sopper,
and H.W. Lull (eds.), Forest Hydrology. Pergamon Press,
Oxford. 527-543.
- Holman, G., and W.A. Evans. 1964.
Stream clearance project - Completion Report Noyo River,
Mendocino County. Calif. Fish Game, Inland Fish. Admin.
Rep. 64-10. 13 pp.
- Hsieh, F.S. 1970.
Storm runoff response from road building and logging on small
watersheds in the Oregon Coast Range. M.S. Thesis, Oregon
State Univ. 149 pp.
- Huston, J.E. 1964.
Stream improvement to increase cutthroat spawning runs.
Montana Fish and Game Dept. (Mimeo).
- Kay, A.R., and R.B. Lewis. 1970.
Passage of anadromous fish through highway drainage structures.
Calif. Dept. of Public Works, Res. Dept., 629110.
- Lance, R.L. 1971.
Influence of water temperature on fish survival, growth and
behavior. In: Proc. Sym. Forest Land Uses and Stream
Environment, Oct. 19-21, 1970. Oregon State Univ. 182-193.
- Klock, G.O. 1971.
Stream flow nitrogen loss following forest erosion control
fertilization. U.S.D.A. Forest Serv., Pac. N.W. Forest and
Range Exp. Sta., Res. Note PNW-169. 9 pp.
- Kouner, J.L. 1956.
Evapotranspiration and water yields following forest cutting
and natural regrowth. In: Proc. Soc. Amer. Foresters,
October 15-17, 1956. 106-110.

FISH

- Lickens, G.E., F.H. Bormann, N.M. Johnson, D.W. Fisher, and R.S. Pierce.
Effects of forest cutting and herbicide treatment on nutrient budgets in the Hubbard Brook watershed - ecosystem. Ecol. Monogr., 40(1):23-47.
- Lull, H.W., and K.G. Reinhart. 1965.
Logging and erosion on rough terrain in the east. In: Proc. of Fed. Interagency Sed, Conf., 1963. U.S.D.A. Misc. Publ. No. 970. 43-47.
- Martin, I.L., and E.R. Tinney. 1962.
Logging in Westcoast watershed shows no effect on area's water yield. Timberman 63(5):46-48.
- McCall, M. 1970.
The effects of aerial forest fertilization on water quality for two streams in the Capitol forest. Wash. State Dept. Ecol., Oct. 1970. 15 pp.
- McClellan, T.J. 1970.
Fish passage through highway culverts. U.S. Dept. of Transport.
- McKinley, W.R., and R.D. Webb. 1956.
A proposed correction of migratory fish problems at box culverts. Wash. Dept. of Fish., Fish. Res. Papers 1(4):33-45.
- McKinley, W.R., and R.D. Webb. 1966.
Facilities at culvert installations. Wash. Dept. of Fish.
- McNeil, W.J. 1968.
Effect of stream flow on survival of pink and chum salmon in spawning beds. In: Myred (ed.). Logging and Salmon. Proc. of a Forum sponsored by the Amer. Inst. Fish. Res. Biol., Alaska District, Juneau, Alaska. 96-114.

FISH

- Megahan, W.F. 1972.
Logging, erosion, sedimentation - are they dirty words?
J. Forestry 70(7).
- Megahan, W.R., and W.J. Kidd. 1972.
Effects of logging and logging roads on erosion and sediment
deposition in steep terrain. J. Forestry 70(3):136-141.
- Merrell, T.R. 1951.
Stream improvement as conducted in Oregon on the Clatskanie
River and tributaries. Fish. Comm. Oregon, Res. Briefs
3:41-47.
- Metsker, H.E. 1970.
Fish versus culverts. Etr-7700-5, U.S.D.A.
- Norris, S.A., and D.G. Moore. 1971.
The entry and fate of forest chemicals in stream. In: Proc.
Sym. Forest Land Uses and Stream Environment, Oct. 19-21. 1970,
Oregon State Univ. 138-158.
- Phillips, R.W. 1971.
Effects of sediment on the gravel environment and fish
production. In: Proc. Sympos. - Forest Land Uses and Stream
Environment, Oct. 19-21, 1970, Oregon State Univ. 64-74.
- Reinhart, K.G., and A.R. Eschner. 1962.
Effect on streamflow of four different forest practices in
the Allegheny Mountains. J. Geophys. Res. 67(6):2433-2445.
- Rotacher, J. 1971.
Regimes of streamflow on their modification by logging.
In: Proc. Sympos. Forest Land Uses and Stream Environment,
Oct. 19-21, 1970, Oregon State Univ. 40-54.

FISH

Rowe, P.B. 1963.

Streamflow increases after removing woodland - riparian vegetation from a Southern California watershed.
J. Forestry 61(5):365-370.

Schaumaburg, F.D. 1970.

The influence of log rafting on water quality. 1969-70
Ann. Rep. Res. Proj. WP-01320-01. Dept. of Civil Eng.,
Oregon State Univ. 68 pp, and 4 tech. publ.

Servizi, J.A., D.W. Martens, and R.W. Gordon. 1970.

Effects of decaying bark on incubating salmon eggs.
Int. Pac. Sal. Fish Comm. Prog. Rep. No. 24. 28 pp.

Shapley, S.P., and D.M. Bishop. 1965.

Sedimentation in a salmon stream. J. Fish. Res. Bd. Canada
22(4):919-928.

Sheridan, W.L. 1969.

Effects of log debris jams on salmon spawning riffles in
Saginaw Creek---. U.S.D.A. Forest Serv., Alaska Region,
February, 1969. 12 pp.

Sheridan, W.L., and W.J. McNeil. 1968.

Some effects of logging on two salmon streams in Alaska.
J. Forestry 66(2):128-134.

Tebo, L.B., Jr. 1955.

Effects of siltation, result from improper logging on the
bottom fauna of a small trout stream in the southern
Appalachians. Proj. Fish-Cultural 17(2):64-70.

Thut, R.N., and E.P. Hayou. 1971.

Effects of forest chemicals on aquatic life. In: Proc.
Sympos. - Forest Land Uses and Stream Environment, Oct. 19-21,
1970, Oregon State Univ. 159-171.



FISH

Wedermeyer, G. 1973.

Some physiological aspects of sublethal heat stress in the juvenile steelhead trout (*Salmo gairdneri*), and coho salmon (*Oncorhynchus kisutch*). J. Fish. Res. Bd. Canada 30(6):831-834.

Zelt, K.A. 1970.

The mayfly (Ephemeroptera) and Stonefly (Plecoptera) fauna of a foothill stream in Alberta, with special reference to sampling techniques. Res. Report No. 6. Alberta Fish and Wildlife Division, Edmonton. 93 pp.

Ziemer, G. 1961.

Culverts. Alaska Department of Fish and Game (Memo). 2 pp.

REGIONAL HISTORY

Pack Saddles to Tete Jaune Cache by
J.C. MacGregor.

History of Alberta - J.C. MacGregor.

Historic Sites of Alberta Hugh Dempsey, 1929.

This is Alberta - Ken E. Liddell.

History of the Province of Alberta
- Archibald Oswald MacRae, 1912.

Grande Prairie - Capital of the Peace
- Isabel M. Campbell.

ROADS AND HARVESTING

- Adamovich, L., and J.B. Webster. 1968.
Road Location and Construction in U.B.C. Forest Area.
Truck Logger, August, 1968. 4 pp.
- Adamovich, L. 1971.
Geometric design standards of forest roads: an aesthetic
view. 8th Canadian Roadside Development Conference, June, 1971.
Center for Continuing Education, U.B.C. 13 pp.
- Adamovich, L. 1971.
Historical perspective of forest road development in B.C.
8th Canadian Roadside Development Conference, June, 1971.
Center for Continuing Education, U.B.C. 17 pp.
- Ainscough, G.L. 1971.
Forest access roads - Public use. 8th Canadian Roadside
Development Conference, June, 1971. Center for Continuing
Education, U.B.C. 7 pp.
- Akesson, H.A. 1963.
"Drainage of Forest Roads". Pulp and Paper Magazine of Canada,
Vol. 64 (X). Pages WR382-WR391, or Canadian Pulp and Paper
Association, Woodland Section, Index No. 2260.
- Anderson, Henry, W. 1954.
"Suspended Sediment Discharge as Related to Streamflow,
Topography, Soil, and Land Use." American Geophysics Union,
Trans. 35. 268-281.
- Anderson, Henry, W. 1970.
"Principal Components Analysis of Watershed Variables Affecting
Suspended Sediment Discharge After a Major Flood." International
Association of Scientific Hydrology, Publication 96. 404-416.
- Anderson, H.W. 1963.
Some interpretations of sediment sources and causes. Pacific
Coast Basins in Oregon and California. Federal Interagency
Sedimentation Conference, Paper 2. U.S.D.A. Miscellaneous
Publication 970. 8 pp.



ROADS AND HARVESTING

- Andre, J.E., and H.W. Anderson. 1961.
"Variation of Soil Erodibility with Geographic Zone, Elevation and Vegetation Type on Northern California Wildlands."
Journal of Geophysical Research, Vol. 66(X). 3351-3357.
- Baldwin, H.I. 1969.
"Seeding Logging Roads to Control Erosion." Fox Forestry Notes, No. 76. New Hampshire Forestry and Recreation Commission. 1 p.
- Beasley, R.P. 1972.
Erosion and sediment pollution control. Iowa State University Press, Ames, Iowa. Book, refs., and illustrations. 320 pp.
- Berndt, H.W. 1965.
"Snow Accumulation and Disappearance in Lodgepole Pine Clearcut Blocks in Wyoming." Journal of Forestry, Vol. 63. 88-91.
- Bethlahmy, N. 1967.
"Effect of Exposure and Logging on Runoff and Erosion."
U.S.D.A. Forest Service, Intermountain Forest and Range Experiment Station, Research Note INT-61.
- Bethlahmy, N., and W.J. Kidd. 1966.
"Controlling Soil Movement from Steep Road Fills." U.S.D.A. Forest Service, Intermountain Forest Range Experiment Station, Research Note INT-45. 4 pp.
- Bethlahmy, N. 1960.
Fertilizer helps establish grass seedlings on abandoned logging roads. Journal of Forestry 58(12). 2 pp.
- Bishop, D.M., and M.E. Stevens. (undated)
"Landslides on Logged Areas in Southeast Alaska." U.S.D.A. Forest Service, Research Paper INT-21.

ROADS AND HARVESTING

- Blaser, R.E., and W.H. McKee. 1967.
Regeneration of woody vegetation along roadsides. Highway Research Record 161, Washington, D.C. 104-112.
- Briggs, W.M. 1969.
Roadside erosion survey. Soil Conservation, Volume 35, No. 2, September 1969. Page 27 (2 pp.).
- British Columbia Forest Service. 1972.
Planning guidelines for coast logging operations. B.C. Forest Service or Truck Logger, December 1972. Page 28 (2 pp.).
- Brock, R.M. 1956.
Stabilization of forest truck roads. B.C. Lumberman 40(5), May 1956. Page 20 (7 pp.).
- Brooks, C.R., and R.E. Blaser. 1963-64.
Effect of fertilizer slurries used in hydro-seeding on seed viability. Highway Research Record, No. 53. Page 3 (5 pp.).
- Brown, G.W., and J.T. Krygier. (undated)
"Clear-cut Logging and Sediment Production in the Oregon Coast Range." Water Resources Research, Vol. 7(V). 1189-1198.
- Brown, W.G.E. 1956.
"Roads and Land." Timber of Canada. Reprint by Canadian Department of Northern Affairs and National Resources, February 1956. 7 pp.
- Bruce, J.B. 1971.
Recreation and roads: The changing emphasis. 8th Canadian Roadside Development Conference, June 1971. Center for Continuing Education, U.B.C. 12 pp.



ROADS AND HARVESTING

Bruce, J.P. 1959.

"Rainfall Intensity-Duration-Frequency Maps for Canada."
Department of Transport, Meteorological Branch, Technical
Circular Series, Circ. 4015, Tech. 518.

Bullard, W.E. 1963.

Effect of highway construction and maintenance on stream
sediment load. Federal Interagency Sedimentation Conference,
Paper 7, U.S.D.A. Miscellaneous Publication 970. 5 pp.

Bureau of Public Roads. 1969.

Literature references to highways and their environmental
considerations. Environmental Development Division. Bureau
of Public Roads, U.S. Dept. of Transportation, Federal Highways
Administration, Washington, D.C. 20591. 137 references. 77 pp.

Bureau of Public Roads. 1937.

Experimental erosion control on forest highway fills.
Public Roads, Volume 18, No. 9, November 1937. Page 176 (7 pp.).

Burns, J.E. 1970.

"The Importance of Streamside Vegetation to Trout and Salmon
in British Columbia." Department of Recreation and Conservation,
Fish and Wildlife Branch, Vancouver Island Region, Nanaimo, B.C.
Fish Technical Circular 1. 10 pp.

Burns, J.W. 1970.

"Spawning Bed Sedimentation Studies in Northern California
Streams." California Fish and Game, Vol. 56(IV). 253-270.

Burroughs, E.R., Jr., M.A. Marsden, and H.F. Haupt. 1972.

"Volume of Snow Melt Intercepted by Logging Roads." A.S.C.E.
Journal of the Irrigation and Drainage Division, Proceedings,
Vol. 98 (IRI). 12 pp.

Byrne, J.J., R.S. Nelson, and P.H. Googins. 1960.

"The Effect of Road Design on Hauling Costs." U.S. Department
of Agriculture, Logging Road Handbook No. 183. 65 pp.

ROADS AND HARVESTING

Cauvin, D.M. 1972.

Measurement of a Forest's Contribution to the Economy of Alberta.
Unpublished Thesis.

Chapman, D.W. 1962.

"Effects of Logging Upon Fish Resources of the West Coast."
Journal of Forestry, Vol. 60. 533-537.

Cleaves, A.B. 1961.

"Landslide Investigation - A Field Handbook for Use in Highway
Location and Design." U.S. Department of Commerce, Bureau of
Public Roads, U.S. Government Printing Office. 67 pp.

Coffman, B.S., and J.S. Sawhney. 1965.

Fertilization and erosion on a new highway. Highway Research
Record No. 93, Washington, D.C. Page 2 (23 pp.).

Cole, D.W. 1966.

"The Forest Soil Retention and Flow of Water." Society of
American Foresters, Proceedings, Seattle, Washington. 150-154.

Colman, E.A. 1953.

Vegetation and Watershed Management. Ronald Press Co.,
New York. 412 pp.

Corrugated Metal Pipe Institute. (undated)

"Solving Drainage Problems with Steel Pipe." Technical
Manual, Crestview Plaza, Port Credit, Ontario.

Crown Zellerbach. 1972.

Environmental guide - Northwest Timber Operations. 32 pp.

Dachlen, K. 1972.

"Construction Standards in Relation to Terrain Conditions -
Roads in Rock." E.C.E., F.A.O., I.L.O., Symposium on Forest
Road Construction and Maintenance Techniques, Hungary,
Item 2.2, Log-Sump. 6/27. 6 pp.



ROADS AND HARVESTING

- Debell, D.S., and W.M. Fergerson. 1972.
Soils information: an indispensable tool for intensive forest management. Crown Zellerbach, Central Research, Camas, Washington. Forestry Research Note No. 1, December 1972. 6 pp.
- Dooling, P.J. 1971.
"Response to the Report - 'Forest Management in Wyoming - Timber Harvest and the Environment on the Teton, Bridger, Schoshone, and Bighorn National Forests, 1971'." U.S.D.A. Forest Service, Rocky Mountain & Intermountain Regions. 18 pp.
- Dudeck, A.E., N.P. Swanson, and A.R. Dedrick. 1967.
Mulches for grass establishment on steep construction slopes. Highway Research Record, No. 206, Washington, D.C. Page 53 (7 pp.).
- Dunford, G. 1960.
"Logging Methods in Relation to Streamflow and Erosion." 5th World Forestry Congress, Proceedings. 1703-1708.
- Dyrness, C.T. 1964.
"Erodibility and Erosion Potential of Forest Watersheds." Pennsylvania State University, International Symposium on Forest Hydrology, reprinted by Pergamon Press, Oxford and New York, August 29, 1964. 13 pp.
- Dyrness, C.T. 1967.
"Grass-Legume Mixtures for Roadside Soil Stabilization." U.S.D.A. Forest Service, Pacific Northwest Forest and Range Experiment Station, Research Note PNW-71. 18 pp.
- Dyrness, C.T. 1967.
"Mass Soil Movements in the H.J. Andrews Experimental Forest." U.S.D.A. Forest Service, Pacific Northwest Forest and Range Experiment Station, Research Paper PNW-42. 12 pp.

ROADS AND HARVESTING

Dyrness, C.T. 1965.

"Soil Surface Condition Following Tractor and High Lead Logging on the Oregon Cascades." Journal of Forestry, Vol. 63(IV). 272-275.

Dyrness, C.T. (undated)

"Stablization of Newly Constructed Road Backslopes by Mulch and Grass-legume Treatments." U.S.D.A. Forest Service, Pacific Northwest Forest & Range Experiment Station, Research Note PNW-123. 5 pp.

Dyrness, C.T., and C.T. Youngberg. 1957.

"The Effect of Logging and Slash Burning on Soil Structure." Soil Science Society of America, Proceedings 21. 444-447.

Dyrness, C.T., C.T. Youngberg, and R.H. Ruth. 1957.

"Some Effects of Logging and Slash Burning on Physical Soil Properties in the Corvallis Watershed." U.S.D.A. Forest Service, Pacific Northwest Forest & Range Experiment Station, Research Note 19.

Edwards, H.M., and D.L. Townsend. 1961.

"General Pulp & Paper Association, Woodland Section, Index No. 2092 (B-8-b), or Pulp & Paper Magazine of Canada, Vol. 62(IX). 153-171.

Environmental Protection Agency. 1973.

Environmental impact statement guidelines. U.S. Environmental Protection Agency, Region X, Seattle, Washington. 123 pp., and 10 appendix sections.

Environmental Protection Agency. 1971.

Control of sediments from highway construction and land development. U.S. Government Printing Office, Washington, D.C. September 1971. 50 pp.

Ellison, L., and J.E. Coaldrake. 1954.

"Soil Mantle Movement in Relation to Forest Clearing in South-Eastern Queensland." Ecology, Vol. 37. 380-388.

ROADS AND HARVESTING

Evans, W.A. 1959.

The effect of current West coast logging practices upon fisheries resources. Society of American Foresters, Meeting Proceedings. Page 106 (3 pp.).

Farmer, H.D., and A.B. Leivellen. 1937.

Channel changes on forest highways. Public Roads, Vol. 18, No. 9, November 1937. Page 169 (7 pp.).

Federal Water Pollution Control Administration. 1970.

"Industrial Waste Guide on Logging Practices." U.S. Department of the Interior, Northwest Region, Portland, Oregon, 97205. 40 pp.

Forest Service. U.S. Department of Agriculture. 1971.

Erosional effects of timber harvest. "Clearcutting" practices on national timberlands. U.S. Senate. Part 3. Page 1202 (18 pp.).

Forest Service Manual. 1970.

"Title 7700 - Transportation System", October 1970, Amendment No. 8; August 1970, Amendment No. 7; July 1972, R-6 Supplement No. 18. 18 pp.

Fredricksen, R.F. 1963-65.

"Sedimentation after Logging Road Construction in a Small Western Oregon Watershed." Federal Interagency Sedimentation Conference, Proceedings, 1963, U.S.D.A. Miscellaneous Publication No. 970, 1965.

Fredriksen, R.L. 1963.

"A Case History of a Mud and Rock Slide on an Experimental Watershed." U.S.D.A. Forest Service, Pacific Northwest Forest and Range Experiment Station, Research Note PNW-1. 4 pp.

Fredriksen, R.L. 1970.

"Erosion and Sedimentation Following Road Construction and Timber Harvest on Unstable Soils in Three Small Western Oregon Watersheds." U.S.D.A. Forest Service, Pacific Northwest Forest and Range Experiment Station, Research Paper PNW-104. 15 pp.



ROADS AND HARVESTING

Gardner, R.B. 1967.

Major environmental factors that affect the location, design and construction of stabilized forest roads. *Loggers Handbook*. Vol. 38. 5 pp.

Gardner, R.B. (undated)

"Forest Road Standards as Related to Economics and the Environment." U.S.D.A. Forest Service, Intermountain Forest and Range Experiment Station, Research Note INT-145.

Garrison, G.A., and R.S. Rummel. 1951.

"First Year Effects of Logging on Ponderosa Pine Forest Range Lands of Oregon and Washington." *Journal of Forestry*, Vol. 49. 708-713.

Geale, C.H. 1966.

"Guides for Controlling Erosion." 1966.
Alberta Department of Lands and Forests. Page 39.

Glasner, K. 1967.

Legislation concerning public access to private roads - from the point of view of a forest company. *U.B.C. Law Review*, 1967-68. 6 pp.

Goss, R.L. 1969.

Research on turf grass for highway use. 6th Western Canadian Roadside Development Conference. U.B.C. 5 pp.

Gray, D.H. 1969.

"Effects of Forest Cutting on the Stability of Natural Slopes." University of Michigan, Department of Civil Engineering, Publication. 67 pp.

Hafner, F. 1972.

"Surveying Techniques Appropriate to Forest Road Work." E.C.E., F.A.O., I.L.O., Symposium of Forest Road Construction and Maintenance Techniques, Hungary. Log/Symp., 6/4, May 5, 1972. 34 pp.

ROADS AND HARVESTING

- Hafner, F. 1972.
Culvert construction techniques. F.C.E., F.A.O., I.L.O.
Symposium on Forest Road Construction and Maintenance
Techniques. Hungary, September 1972. Log/Symp. 6/21. 7 pp.
- Hall, J. 1968.
Effects of logging on fish resources. Loggers Handbook,
Vol. XXVIII. Page 24 (5 pp.).
- Hamill, Louis. 1971.
"Classification of Forest Land for Recreation Potential and
Scenery." The Forestry Chronicle, University of Calgary,
Department of Geography, June 1971. 5 pp.
- Haupt, H.F. 1959.
"A Method for Controlling Sediment from Logging Roads."
U.S.D.A. Forest Service, Intermountain Forest and Range
Experiment Station, No. 22, Miscellaneous Publications. 22 pp.
- Haupt, H.F. 1959.
"Road and Slope Characteristics Affecting Sediment Movement
from Logging Roads." Journal of Forestry, Vol. 56. 329-332.
- Haupt, H.F., and W.J. Kidd. 1965.
"Good Logging Practices Reduce Sedimentation in Central Idaho."
Journal of Forestry, Vol. 63(IX). 664-670.
- Haupt, H.F., H.C. Richardson, and L.E. Finn. 1963.
"Effect of Severe Rainstorms on Insloped and Outsloped Roads."
U.S.D.A. Forest Service, Intermountain Forest and Range
Experiment Station, Research Note No. INT-1. 8 pp.
- Heede, H.H. 1960.
"A Study of Early Gully Control Measures in the Colorado Front
Range." U.S.D.A. Forest Service, Rocky Mountain Forest and
Range Experiment Station, Research Paper 55. 42 pp.

ROADS AND HARVESTING

- Hockensmith, E.D., and J.G. Steele. 1971.
"Soil Erosion - The Work of Uncontrolled Water." Soil Conservation Service, U.S. Department of Agriculture, Information Bulletin 260, Revised, December 1971. 15 pp.
- Hodder, R. 1970.
"Maintenance for Erosion Control." 7th Western Canadian Roadside Development Conference, University of Victoria. 100-106.
- Hoffmeister, B.M. 1965.
Logging roads and the public interest. Truck Loggers Convention B.C. February 1965. 11 pp. Or Pulp and Paper Magazine of Canada, 66(9). Pages WR392-WR395.
- Hombeck, J.W., and K.C. Reinhart. 1964.
"Water Quality and Soil Erosion as Affected by Logging in Steep Terrain." Journal of Soil and Water Conservation, Vol. 19, January to February 1964. 23-27.
- Hoover, M.D. 1952.
"Water and Timber Management." Journal of Soil and Water Conservation, Vol. 7. 75-78.
- Hough, Stansbury and Associates. 1972.
Design guidelines for forest management. Ontario Ministry of Natural Resources. 29-44.
- Hudson, D.W. 1967,
Salt as a stabilizing agent for woods truckroads. Pulp and Paper Magazine of Canada, 1967, 68(7). Pages WR327-WR332. Or Woodland Section Index, Canadian Pulp and Paper Assoc. No. 2416.
- Hutnik, R.J., and S. Weitzman. 1957.
"Gentle-grade Roads Mean Faster Skidding." U.S.D.A. Forest Service, Northeast Forest Experiment Station, Research Note No. 71.

ROAD AND HARVESTING

- Jackman, R.E., and N.N. Stoneman. 1973.
Roadside grassing - a fast logging practice for redwood forests.
Journal of Forestry, February 1973. Page 90 (3 pp.).
- Jeffrey, W.W., C.S. Brown, M. Jundant, N.S. Novakowski, and
P.H. Spilsburg. 1970.
Toward integrated resource management. Report of the Sub-
Committee on multiple use, National Committee on Forest Land,
Department of Regional Economic Expansion, Ottawa. 46 pp.
- Kidd, W.J. 1963.
"Soil Erosion Control Structures on Skidtrails." U.S.D.A.
Forest Service, Intermountain Forest and Range Experiment
Station, Research Paper INT-1.
- Kidd, W.J., and H.F. Haupt. 1968.
"Effects of Seedbed Treatments on Grass Establishment on Logging
Roads in Central Idaho." U.S.D.A. Forest Service, Intermountain
Forest and Range Experiment Station, Research Paper No. INT-53.
9 pp.
- Kidd, W.J., and J.N. Kochenderfer. 1973.
Soil constraints on logging road construction on steep land East
and West. Journal of Forestry, Vol. 71, No. 5, May 1973.
Page 284 (3 pp.).
- Kimmins, J.P. 1971.
"Ecology of Roads." 8th Canadian Roadside Development
Conference, U.B.C., June 1971. 10 pp.
- Kochenderfer, J.N. 1970.
"Erosion Control on Logging Roads in the Appalachians." U.S.D.A.
Forest Service, Northeast Forest Experiment Station, Research
Paper NE-158. 28 pp.
- Koziol, F.C. 1954.
Problems of winter use on forest lands. Journal of Forestry
52 (11). Page 819 (5 pp.).

ROADS AND HARVESTING

- Lager, K.F. 1966.
"Prevent Logging Damage to Streams." Department of Recreation-Conservation, British Columbia.
- Lantz, R.L. 1971.
"Guidelines for Stream Protection in Logging Operations." Oregon State Game Community, Research Division, Portland, Oregon. Page 29.
- Larse, R.W. 1970.
Prevention and control of erosion and stream sedimentation from forest roads. Symposium on Forest Land Uses and Stream Environment. Oregon State University. Page 76 (8 pp.).
- Leaf, Charles F. 1970.
"Sediment Yields from Central Colorado Snow Zone." American Society of Civil Engineers, Journal of the Hydraulics Division, Proceedings, January 1970. 7 pp.
- Leaf, Charles F. 1966.
"Sediment Yields from High Mountain Watersheds-Central Colorado." U.S.D.A. Forest Service, Research Paper RM-23. 15 pp.
- Lees, J.C., A.A. Loman, and J.M. Powell. 1971.
"Some Implications of Large-scale Clearcutting in Alberta - A Literature Review." Canadian Forestry Service, Department of the Environment, Northern Forest Research Centre, Edmonton, Alberta, Information Report NOR-X-6. 114 pp.
- Levin, D.R. 1967.
Scenic roads and parkways. Highway Research Record, No. 161, Washington, D.C. Page 30 (4 pp.).
- Lewis, J.H., and R.W. McDermid. 1967.
Public Recreational Use of private forests in Louisiana. Bulletin La. Agric. Exp. Station No. 618. 24 pp.



ROADS AND HARVESTING

Lieberman, J.A., and M.D. Hoover. 1948.

"Protecting Quality of Streamflow by Better Logging."
Southern Lumberman, December 15, 1948. 236-240.

Litton, R. 1968.

Forest landscape description and inventories. A basis for land planning and design. U.S.D.A. Forest Service, Research Paper PSW-49. Pacific Southwest Forest and Range Experimental Station. 64 pp.

Lotspeich, F.B. 1971.

Environmental guidelines for road construction in Alaska. Environmental Protection Agency, Alaska Water Laboratory, College, Alaska. 121 pp.

Love, S.K., and P.C. Benedict. 1948.

"Discharge and Sediment Loads in the Boise River Drainage Basin, Idaho - 1939-40." U.S. Geological Survey, Water Supply Paper 1048.

Lull, H.W. 1959.

"Soil Compaction on Forest and Range Lands." U.S.D.A. Forest Service, Miscellaneous Publication 768. 33 pp.

Lull, Howard W., and Kenneth G. Reinhart. 1972.

Forests and floods in the Eastern United States. NE. Forest Exp. Sta., Upper Darby, Pa. U.S.D.A. Forest Service Research Paper NE-226. 94 pp.

McCracken, Joseph W. 1972.

"Impact of Federal Legislation on Forest Land Management." Rocky Mountain Forest Industries, Conference Proceedings.
"Moving Toward Environmental Solutions in Forest Products Management." Colorado State University, April 10-12, 1972. 29-34.



ROADS AND HARVESTING

McCraw, W.E. 1963.

"Truck Road Standards and Hauling Costs." Canadian Department of Forestry, Forest Products Research Branch, Contribution No. P-32. Reprinted from British Columbia Lumberman, August 1963.

McDonald, P.M., and R.V. Whitely. 1972.

Logging a roadside stand to protect scenic values. Journal of Forestry 70(2). Page 80 (3 pp.).

McFarlane, H.W., L.R. Seheult, and A.M. Stevens. 1963.

Comparing different road qualities. Pulp and Paper Magazine of Canada 64(1). Pages WR15-WR20, or Woodland Section Index, Canadian Pulp and Paper Association No. 2189.

McFarlane, H.W. 1963.

"Sub-grade - A Major Factor in Road Construction." Pulp and Paper Magazine of Canada, Vol. 64(II). Pages WR417-WR428.

McFarlane, H.W., W.G. Paterson, and W.J. Dohaney. 1968.

"The Selection and Use of Forest Road Building Materials." Pulp and Paper Research Institute of Canada, Woodlands Paper No. 1. 175 pp.

McKee, W.H., R.E. Blaser, and D.G. Barkley. 1964.

Mulches for steep cut slopes. Highway Research Record No. 53, Washington, D.C. Page 35 (8 pp.).

McNally, J.A. 1963.

"Mechanized Logging and Road Requirements." Canadian Pulp & Paper Association, Woodlands Section Index No. 2258. 6 pp.

McRorey, R.P., N.F. Meadowcroft, and C.J. Kraebel. 1954.

"A Guide to Erosion Reduction on National Forest Timber Sale Areas." U.S.D.A. Forest Service, California Region. 78 pp.

ROADS AND HARVESTING

Machanchlan, R.S. 1966.

Grasses and legumes for stabilizing silt producing areas in the northwest. (U.S.A.) Symposium on practical aspects of Forest Watershed Management, Oregon State University, March 1966. Page 75 (11 pp.).

Martin, I.L., and E.R. Tinney. 1962.

"Logging in West Coast Watershed Shows no Effects on Area's Water Yield." The Timberman. 46-48.

Meehan, W.R., and others. 1969.

Some effects of clear cutting on salmon habitat of two south-east Alaska streams. U.S.D.A. Forest Service, Pacific Northwest Forest and Range Experiment Station, Research Paper PNW-82. 45 pp.

Megahan, W.F. 1972.

Logging, erosion, sedimentation: are they dirty words? Journal of Forestry, Vol. 70, July 1972. Page 403 (5 pp.).

Megahan, W.F., and W.J. Kidd. 1972.

"Effects of Logging and Logging Roads on Erosion and Sediment Deposition from Steep Terrain." Journal of Forestry, Vol. 70, March 1972. 136-141.

Megahan, W.F., and W.J. Kidd. 1972.

"Effect of Logging Roads on Sediment Production Rates in the Idaho Batholith." U.S.D.A. Forest Service, Intermountain Forest and Range Experiment Station, Research Division, Research Paper INT-123. Page 14.

Middleton, H.E. 1930.

"Properties of Soils Which Influence Soil Erosion." U.S.D.A. Forest Service, Technical Bulletin No. 178.

Miner, N.H. 1968.

Natural filtering of suspended soil by a stream at low flow. U.S. Forest Service, Pacific Northwest Forest and Range Experiment Station, Research Note PNW-88. 4 pp.

ROADS AND HARVESTING

Mitchell, A.S. 1973.

Haul road cost estimates: key to efficient logging.
British Columbia Lumberman, January 1973. Page 44 (1 p.).

Mitchel, W., and G. Trimble. 1959.

"How much Land is Needed for the Logging Transport System."
Journal of Forestry, Vol. 57. 10-12.

Moessner, K.E. 1960.

Estimating the area in logging roads by dot sampling on
aerial photographs. U.S.D.A. Forest Service, Intermountain
Forest and Range Experiment Station, Research Note No. 77.
4 pp.

Mollard, J.D. 1972.

Landforms and landscapes of Canada: a stereoscopically
illustrated guide to airphoto identification and interpretation.
J.D. Mollard and Associates Ltd., Regina, Sask. A manual with
over 500 illustrations.

Narver, D.W. 1970.

Effects of logging debris on fish production. Symposium on
Forest Land Uses and Stream Environment. Oregon State
University. 12 pp., many refs.

National Academy of Sciences. 1970.

Land use and wildlife resources. Washington, D.C. Book.

National Park Service. 1968.

"Park Road Standards." U.S. Department of the Interior,
U.S. Government Printing Office, May 1968.

National Research Council. 1955.

Proceedings of the Western Muskeg Research Meeting. Technical
Memorandum No. 38, Ottawa. 25 pp.

ROADS AND HARVESTING

O'Loughlin, C.L. 1972.

"A Preliminary Study of Landslides in the Coast Mountains of Southwestern British Columbia." Mountain Geomorphology, H.O. Slaymaker, and H.J. McPherson, (Eds.), Tantalus Research Vancouver. 101-111.

Oregon State University. 1970.

"Forest Land Uses and Stream Environment." Continuing Education Publications, Waldo 100, Corvallis, Oregon, 97331. 252 pp.

Osteras, T. 1972.

"The Influence of Geology on the Construction and Layout of Forest Road Networks." E.C.E., F.A.O., I.L.O., Symposium on Forest Road Construction and Maintenance Techniques, Sopron (Hungary), Log/Symp., 6/3, May 4, 1972.

Packer, P.E. 1967.

"Criteria for Designing and Locating Logging Roads to Control Sediment." Forest Science, Vol. 13(I). 2-17.

Packer, P.E., and G. Christensen. 1964.

"Guidelines for Controlling Sediment from Secondary Logging Roads." U.S.D.A. Forest Service, Intermountain Forest and Range Experiment Station, Ogden, Utah, and Northern Region Missoula, Montana. 42 pp.

Paterson, W.G., H.W. McFarlane, and W.J. Dohaney. 1972.

"A Proposed Forest Road Classification System." E.C.E., F.A.O., I.L.O., Joint Committee on Forest Working Techniques & Training of Forest Workers, Symposium on Forest Road Construction & Maintenance Techniques, Sopron (Hungary), 6-8 September 1972, Log/Symp., 6/6, June 14, 1972. 45 pp.

Peters, J.D., and others. 1973.

Promising materials and methods for erosion control. Highway Research Board, Washington, D.C. Special Report No. 135. Page 105 (13 pp.).



ROADS AND HARVESTING

Peterson, E.B., and H.M. Etter. 1970.

A background for disturbed land reclamation and research in the Rocky Mountain region of Alberta. Canadian Forestry Service, Department of Fisheries and Forestry, Forest Research Laboratory, Edmonton, Alberta, Information Report A-X-34. 44 pp., 67 refs.

Peterson, R.M. 1960.

"Stabilization of Cut and Fill Slopes." Third Annual Technical Work Planning Conference of Forest Service Scientists, San Dimas.

Phillips, R. 1970.

Effects of sediment on the gravel environment and fish production. Symposium on Forest Land Uses and Stream Environment, Oregon State University. Page 64 (10 pp.).

Platts, W.S. 1971.

The effects of logging and construction on the aquatic habitat of the South Fork Salmon River, Idaho. "Clearcutting" practices on national timberlands. United States Senate. U.S. Government Printing Office. Part I. Page 113 (3 pp.).

Ponoet, A. 1964.

Forest roads and erosion in the mountains. Revue Forestiere Francaise, April 1964. Page 267 (19 pp.).

Pragnell, R.C. (undated)

Scenic Road - a basis for its planning, design and management. Forest Service, U.S.D.A., Technical Report ETR-7700-2. Book.

Reinhart, K.G. (undated)

"Effect of a Commercial Clearcutting in West Virginia on Overland Flow and Storm Run-Off." Journal of Forestry, Vol. 62, 1963a. 167-172.

Reinhart, K.G. (undated)

"Efficient Logging Protects Water Quality." Southern Lumberman, Vol. 206 (2567), 1963b. 39-41.

ROADS AND HARVESTING

- Reinhart, K.G., A.R. Eschner, and G.F. Trimble. 1963.
"Effect on Streamflow of Four Forest Practices in the Mountains of West Virginia." U.S.D.A. Forest Service, Northeast Forest Experiment Station, Research Paper NE-1. 79 pp.
- Renney, A.J. 1970.
"Roadside Vegetation Control - Implications." 7th Western Canadian Roadside Development Conference, University of Victoria. 90-100.
- Resler, Rexford A. 1972.
"Role of the Forest Service." Timber Supply and the Environment, Proceedings, Current Issues Conference, University of Oregon. 40-47.
- Rice, R.M., R.P. Crouse, and E.S. Corbett. 1965.
"Emergency Measures to Control Erosion After a Fire on the San Dimas Experimental Forest." U.S.D.A. Forest Service, Federal Interagency Sedimentary Conference, Proceedings, Miscellaneous Publication No. 970. 122-130.
- Rice, R.M., and J.R. Wallis. 1962.
"How a Logging Operation can Affect Streamflow." Forest Industries, November 1962. 38-40.
- Rice, R.M., and J.R. Wallis. (undated)
"Logging Effects on Streamflow and Sedimentation in a High Sierra Watershed." Forest Industries Vol 89. 38-40.
- Robins, J.S., and E.L. Neff. 1963.
"Principles of the Erosion Process." Oregon State University, Forest Watershed Management Symposium, Corvallis, Oregon. 127-139.
- Rothacher, J. 1970.
Regimes of streamflow and their modification by logging. Symposium on Forest Land Uses and Stream Environment, Oregon State University. 14 pp.

ROADS AND HARVESTING

Rothacher, J. 1949.

"How Much Debris Down the Drainage." Timberman, May 29, 1949. 74-77.

Rothacher, J., C.T. Dyrness, and R.L. Fredriksen. 1967.

"Hydrologic and Related Characteristics of Three Small Watersheds in the Oregon Cascades." Pacific Northwest Forest and Range Experiment Station, Corvallis, Oregon. 54 pp.

Rothwell, R.L. 1973.

How to design logging road drainage system.

Canadian Forest Industries, March 1973. Page 37 (4 pp.).

Rothwell, R.L. 1966.

"Logging and Road Construction - Maintenance Rules for Better Watershed Management." Canadian Department of Forestry and Rural Development, Calgary, Alberta.

Rothwell, R.L. 1971.

"Watershed Management Guidelines for Logging and Road Construction." Canadian Forestry Service, Department of Fisheries and Forestry, Forest Research Laboratory, Edmonton, Alberta, Information Report A-X-42. 78 pp.

Sadler, R.S. 1970.

"Buffer Strips - A Possible Application of Decision Theory." U.S.D.I. Bureau of Land Management, Eugene, Oregon. Technical Note. 11 pp.

Scheidt, M.E., and FASCE. 1967.

Environmental effects of highways. Journal of the Sanitary Engineering Division, Proceedings of the American Society of Civil Engineers, Vol. 93, No. SA5, October 1967. Page 17 (9 pp.).

ROADS AND HARVESTING

Sheridan, W.L., and W.J. McNeill. 1968.

"Some Effects of Logging on Two Salmon Streams in Alaska."
Journal of Forestry, Vol. 66(II). 128-133.

Silen, R.R., and H.J. Gratkowski. 1973.

"An Estimate of the Amount of Road in the Staggered Setting
System of Clearcutting." U.S.D.A. Forest Service, Pacific
Northwest Forest and Range Experiment Station, Research
Note No. 92.

Smith, H.J., and R.J. Matthews. 1972.

Environmental tolerances and visitor preferences for some
forest recreation habitats. B.C. Forest Chronicle, June 1972.
Page 133 (5 pp.).

Smith, I.D. 1971.

"Wildlife and Roads." 8th Canadian Roadside Development
Conference, University of British Columbia, June 1971. 13 pp.

Sommer, H.C. 1973.

Managing steep land for timber production in the Pacific
Northwest. Journal of Forestry, Vol. 71, No. 5, May 1973.
Page 270 (4 pp.).

Stewart. 1972

"Reducing Advance Environment Impact Through Improved
Harvesting Methods." 7th World Forestry Congress, Buenos Aires.
October 4-18, 1972. 14 pp.

Stienbrenner, E.C., and S.P. Gersel. 1944.

"Effect of Tractor Logging on Soils and Regeneration in the
Douglas Fir of Southwest Washington." Society of American
Foresters, Proceedings. 77-80.

Stoeckeler, J.H. 1965.

Drainage along swamp forest roads; Lessons from northern
Europe. Journal of Forestry 63(10). Page 772 (6 pp.).

ROADS AND HARVESTING

Stoeckeler, J.H. (undated)

"Westland Road Crossing, Drainage Problems and Timber Damage."
U.S.D.A Forest Service, North Central Forest Experimental
Station, Research Note No. NC-27. 4 pp.

Storr, D. 1963.

"Maximum One-day Rainfall Frequencies in Alberta."
Canadian Department of Transport, Meteorological Branch,
Technical Circular Series, Circular 4015, Technical 513.

Sawnsen, N.P., A.R. Dedrick, and A.E. Dudeck. 1967.

Protecting steep construction slopes against water erosion.
Highway Research Record No. 26, Washington, D.C. Page 46
(77 pp.).

Swanston, D.N. 1970.

Principal mass movement processes influenced by logging road
building and fire. Symposium on Forest Land Uses and Environ-
ment. Oregon State University. Page 29 (12 pp.).

Swanston, D.N., and C.T. Dyrness. 1973.

Stability of steep land. Journal of Forestry, Vol. No. 5,
May 1973. Page 264 (6 pp.).

Telfer, E.S. 1970.

"Relationship Between Logging and Big Game in Eastern Canada."
Canadian Pulp & Paper Association, Woodland Section Index
2566 (B-1), ODC, Vol. 31. 156-161.

The Timberman. (undated)

"How to Make Culverts do a Better Job of Handling Peak Stream
Flows." Vol. 59(1). 68-69.

Thornton, R.B. 1965.

Establishment of vegetation on subsoils. Highway Research
Record No. 93, Washington, D.C. Page 31 (7 pp.).

ROADS AND HARVESTING

- Toogood, J.A., and J.D. Newton. 1955.
"Water Erosion in Alberta." University of Alberta, Edmonton,
Bulletin No. 56.
- Trimble, G.R., Jr. 1959.
"Logging Roads in Northeast Municipal Watersheds."
Journal of American Water Works Association, Vol. 51. 407-410.
- Trimble, G.R., and R.S. Sartz. 1957.
"How Far From a Stream Should a Logging Road be Located."
Journal of Forestry, Vol. 55(V). 339-341.
- Turelle, J.W. 1973.
Factors involved in the use of herbaceous plants for erosion
control on roadways. Highway Research Board, Washington, D.C,
Special Report 135. Page 99 (6 pp.).
- Undi, Stanley. 1972.
"Clearcutting in a Quality Environment." Rocky Mountain Forest
Industries, Conference, Proceedings, "Moving Toward Environmental
Solutions in Forest Products Management." Colorado State
University, April 10-11, 1972. 35-37.
- U.S.D.A. Forest Service. 1966.
"A Manual for Planning and Structural Control of Avalanches."
Research Paper RM-19, May 1966. 68 pp.
- U.S.D.A. Forest Service. 1971.
"Forest Management in Wyoming." Wyoming Forest Study Team.
38-61.
- Waelti, H. 1970.
"Forest Road Planning." Photogrammetric Engineering, March
1970. 7 pp.
- Waelti, H. 1966.
"Interpretation of Forest Stands for Engineering Purposes."
B.C. Professional Engineer, February 1966. 3 pp.

ROADS AND HARVESTING

Wallis, J.R. 1963.

"Logging for Water Quality in Northern California."

U.S.D.A. Forest Service, Pacific Southwest Forest and Range
Experiment Station, Research Note PSW-N23. 7 pp.

Walters, W.T. 1966.

Road design for preservation of land and water values.
Symposium on the Practical Aspects of Forest Watersheds
Management. Oregon State University. Page 85 (8 pp.).

Washington State University. 1959.

"Building Woodland Roads." Institute of Agricultural Sciences,
Extension Service, Extension Circular 304, September 1959.
1 sheet.

Webb, J.R. 1970.

Some aspects of national park roadway planning. 7th Western
Canadian Roadside Development Conference. Page 30 (10 pp.).

Weitzman, S., and G.R. Trimble. 1955.

"Integrated Timber and Watershed Management in Mountain Areas."
Journal of Soil and Water Conservation, Vol. 10. 72-74.

Weitzman, S., and G.R. Trimble. 1952.

"Skidroad Erosion can be Reduced." Journal of Soil and Water
Conservation, Vol. 7. 122-124.

Willington, R.P. 1971.

"Hydrologic Impact of Forest Access Roads." 8th Canadian
Roadside Development Conference, University of British
Columbia, Vancouver, June 1971. 12 pp.

Wilm, H.G., and E.G. Dunford. 1948.

"Effect of Timber Cutting on Water Available for Stream Flow
from Lodgepole Pine Forest." U.S.D.A. Forest Service, Technical
Bulletin 968. 43 pp.

ROADS AND HARVESTING

Winkelaar, P. 1971.

Forest road location and erosion control on northern New Hampshire soils. Cooperative Extension Service, University of New Hampshire and White Mountain National Forest. Forest Service. U.S.D.A. Extension Publication No. 2. 18 pp.

Weschmeier, W.H., and L.D. Meyer. 1973.

Soil erodibility on constructed areas. Highway Research Board, Washington, D.C. Special Report 135. Page 20 (10 pp.).

Wooldridge, D.D. 1964.

"Effects of Parent Material and Vegetation on Properties Related to Soil Erosion in Central Washington." Soil Science Society of America, Proceedings 28(III). 430-432.

Wollum, A.G. 1962.

"Grass Seeding as a Control for Road Bank Erosion." Pacific Northwest Forest and Range Experiment Station, Research Note No. 218. 5 pp.

Wright, D.R. 1968.

Dust control on all weather haul road using chlorides. Pulp and Paper Magazine of Canada, 1968, 69(20). Page 94 (5 pp.).

Young, H.E. 1973.

Management of forest stands on highway right-of-way. Life Sciences and Agriculture Experiment Station, University of Maine at Orono, Vol. 20, Number 12, Research in the Life Sciences, February 1973. 7 pp.

Younkin, L.M. 1973.

Effects on highway construction on sediment loads in streams; Highway Research Board, Washington, D.C. Special Report 135. Page 82 (12 pp.).



ROADS AND HARVESTING

Zah, J.M., and others. 1972.

Direct seeding along highways of woody plant species under a wood chip mulch. Highway Research Board, Washington, D.C. Highway Research Record No. 411. Page 24 (4 pp.).

Zinke, P. 1964-65.

"Influence of Land Use on Floods in Relation to Runoff and Peak Flows." State of California Resources Agency, Department of Conservation, Division of Forestry, Proceedings of the State Board of Forestry Meeting, February 1964, 1965. 47-52.

Zinke, P.J. 1968.

Clean water from a working forest. Proceedings of the 59th Western Forestry Conference. Western Forestry and Conservation Association, December 1968. Page 69 (7 pp.).



SILVICULTURE

Ackerman, R.F. 1962.

Regeneration following strip clear cutting, scarification and slash disposal in a Lodgepole Pine stand. Forest Research Branch, Canada Dept. of Forestry, Ottawa. Technical Note 123. 16 pp.

_____ and H.J. Johnson. 1962.

Continuous planting of White Spruce throughout the frost-free period. Forest Research Branch, Canada Dept. of Forestry. Technical Note 117. 13 pp.

_____ 1963.

Seed release from slash-borne Lodgepole Pine cones after clearcutting. Canada Dept. of Forestry, Forest Research Branch. Established Rep. 17 pp.

Alberta Department of Lands and Forests. 1971.

Twenty-second Annual Report for the fiscal year ended March 31, 1971. 174 pp.

Alexander, R.R. 1958.

Silvical Characteristic of sub-alpine fir. Rocky Mountain Forest & Range Experiment Station Forest Service, U.S. Dept. of Agriculture, Fort Collins, Colorado. Station Paper No. 32. 15 pp.

_____ 1960.

Thinning Lodgepole Pine in the central Rocky Mountains. J.F. 58:2. 99-104.

_____ 1965.

Growth of Thinned young Lodgepole pine in Colorado. J.F. 63:6. 429-433.

_____, David Tackle, and Walter G. Dahms. 1967.

Site Indexes for Lodgepole pine, with corrections for stand density. Rocky Mountain Forest & Range Experiment Station Forest Service, U.S. Department of Agriculture, Fort Collins, Colorado. U.S. Forest Service Research Paper RM-29. 18 pp.

SILVICULTURE

- Anonymous. 1971.
Regeneration Survey Manual. Timber Management Branch,
Alberta Forest Service, Dept. of Lands and Forests.
- Anonymous. 1972.
Partial cutting pays off in Alberta's spruce aspen forests.
Northern Forest Research Centre, Edmonton, Alberta.
Forestry Report, CFS, Vol. 2, No. 2. Page 7.
- _____. 1973.
Sustained yield management in Saskatchewan. MacMillan Bloedel
News, Vol. 10, No. 6. Page 5.
- Arlidge, J.W.C. 1967.
The durability of scarified seedbeds for spruce regeneration.
B.C. Forest Service, Dept. of Lands, Forests and Water Resources,
Victoria, B.C. Research Note No. 42. 20 pp.
- Armit, David. 1966.
Silvics and Silviculture of Lodgepole Pine in the North Central
Interior of British Columbia. B.C. Forest Service, Victoria,
B.C. Research Note No. 40. 50 pp.
- Baranyay, J.A. 1970.
Lodgepole pine dwarf mistletoe in Alberta. Canadian Forestry
Service, Dept. of Fisheries and Forestry Publication No. 1286.
22 pp.
- _____. and G.R. Stevenson. 1964.
Mortality caused by Armillaria Root rot, Peridermium rusts,
and other destructive agents in lodgepole pine regeneration.
Forest Chronicle 40:3. 350-361.
- Barr, P.M. 1930.
The effect of soil moisture on the establishment of spruce
regeneration in British Columbia. Yale University School of
Forestry Bulletin No. 26. 77 pp.

SILVICULTURE

Bella, I.E. 1968.

Estimating aerial component weights of young aspen trees.
Canadian Department of Forestry, Winnipeg, Manitoba.
Fr. Res. Lab. Info. Report MS-X-12. 36 pp.

1972.

Growth of young lodgepole pine after mechanical strip thinning
in Alberta. Nor. For. Res. Centre, C.D.E. Can. For. Serv.,
Edmonton. 16 pp.

Boe, Kenneth, N. 1956.

Regeneration and slash disposal in lodgepole pine clear
cuttings. Northwest Science 30:1. 1-11.

British Columbia Forest Service, Victoria. 1973.

Annual Report for 1972. 119 pp.

Brix, H. 1972.

Growth Response of Sitka spruce and White spruce seedlings to
temperature and light intensity. Pacific Forest Research
Centre, Information Report B.C.-X-74. 17 pp.

Cameron, Hugh. 1953.

Melting point of the bonding material in lodgepole pine and
jack pine cones. Forestry Branch, Canada Dept. of Res. and
Dev. Forest Res. Div. Leaflet 86. 3 pp.

Cayford, J.H., and A. Bickerstaff. 1968.

Man-made forests in Canada. Dept. of Fisheries and Forestry,
Ottawa. Forestry Branch Publication No. 1240. 68 pp.

Cottam, W.P. 1954.

Prevernal leafing of aspen in Utah Mountains. J. Arnold
Arboretum 35(3). 239-250.

SILVICULTURE

Crossley, D.I. 1949.

Reproduction of white spruce in a mixedwood stand following mechanical disturbance of the forest floor. Can. Dept. Mines and Resources, Dominion Forest Service, Ottawa, Research Note No. 90. 25 pp.

1950.

Chemical thinning of young stagnating lodgepole pine stands. Forest Res. Division Forestry Branch, Can. Dept. of Res. and Development, Ottawa. Silvicultural Leaflet No. 42. 1 p.

1952a.

White spruce reproduction resulting from various methods of forest soil scarification. Can. Dept. of Res. and Dev., Ottawa. Silvicultural Research Note No. 102. 18 pp.

1952b.

Some observations on Lodgepole Pine regeneration after clear cutting in strips. Div. of For. Res., Can. Dept. of Res. and Dev., Calgary, Alta. Silv. Leaflet No. 65. 4 pp.

1952c.

Discing overdense Lodgepole Pine reproduction. Forestry Branch Dept. of Res. and Dev., Calgary, Alta. Silv. Leaflet No. 66.

1955.

The production and dispersal of Lodgepole Pine seed. Can. Dept. Northern Affairs and National Resources, Ottawa. Res. Div. Tech. Note No. 25. 12 pp.

1956a.

The possibility of continuous planting of white spruce throughout the frost-free period. For. Res. Div., Can. Dept. of Northern Affairs and National Resources, Forestry Branch, Ottawa. Technical Note No. 32. 31 pp.

SILVICULTURE

1956b.

The chemical control of density in young stagnating stands of Lodgepole Pine. For. Res. Div., Can. Dept. of Northern Affairs and National Resources, Ottawa. Tech. Note No. 39. 17 pp.

Critchfield, William B. 1957.

Geographic Variation in *Pinus contorta*. Harvard University, Cambridge, Mass. Maria Moors Cabot Foundation. 118 pp.

Crosse, J.A., and J.J. Solecki. 1963. (editors)

"Soviet Forestry." Proceedings of the Inter-Faculty Seminar on Forest Resources in the U.S.S.R. and their utilization. Nov.'71-Feb.'72. Faculty of Forestry, University of British Columbia. Mimeo. 124 pp.

Crossley, D.I. 1964.

Report of the Standing Committee on Silviculture. Forestry Chronicle 40:2. 62-70.

Crowe, Sylvia. 1966.

Forestry in the Landscape. Her Majesty's Stationery Office, London. Forestry Commission Booklet No. 18. 31 pp.

Dahms, Walter, G. 1963.

Dispersal of Lodgepole Pine seed into clear-cut patches. Forest Service, U.S. Dept. of Agriculture, Portland, Oregon. Pacific Northwest Forest and Range Experiment Station. Research Note PNW-3. 7 pp.

1964.

Gross and net yield tables for Lodgepole Pine. Pacific Northwest Forest & Research Station, Forest Service, U.S. Dept. of Agriculture, Portland, Oregon. Research Paper No. PNW-8. 14 pp.



SILVICULTURE

1966a.

Relationship of Lodgepole Pine volume increment to Crown computation factor, basal area, and site index. Forest Science 12:1. 74-82.

1966b.

Effect of kind and number of measured tree heights on Lodgepole Pine site-quality estimates. Pacific Northwest Forest and Range Experiment Station, U.S. Department of Agriculture, Portland, Oregon. U.S. Forest Service Research Paper PNW-36. 8 pp.

1967.

Low stand density speeds Lodgepole Pine tree growth. Pacific Northwest Forest and Range Experiment Station, Forest Service, U.S. Dept. of Agriculture, Portland, Oregon. Research Note PNW-47. 11 pp.

1971.

Fifty-five-year-old Lodgepole Pine responds to thinning. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon. Forest Service Research Note PNW-141. 13 pp.

Day, R.J. 1963.

Spruce seedlings mortality caused by adverse summer microclimate in the Rocky Mountains. Forest Research Branch, Department of Forestry (Canada), Ottawa. Publication No. 1003. 36 pp.

1964.

The microenvironments occupied by spruce and fir regeneration in the Rocky Mountains. Canada Dept. of Forestry, Ottawa. Research Branch Publication No. 1037. 25 pp.

1970.

Shelterwood Felling in Late Successional Stands in Alberta's Rocky Mountain Subalpine Forest. F.C. 46:5. 380-386.



SILVICULTURE

1972.

Stand structure, succession, and use of southern Alberta's Rocky Mountain Forest. ECOLOGY 53:3. 472-478.

and P.J.B. Duffy. 1963.

Regeneration after logging in the Crowsnest Forest. Forest Research Branch, Ottawa. Dept. of Forestry Publication No. 1007.

Dixon, G., and H.J. Johnson. 1969.

Preliminary Evaluation of Pilot-Scale Container Planting in the Foothills of Alberta-1967 Planting. Forestry Branch, Dept. of Fisheries and Forestry, Forestry Research Lab., Edmonton. Internal Report A-19.

Dobbs, R.C. 1972.

Regeneration of white and Engelmann spruce. A Literature review with special reference to the British Columbia Interior. Canadian Forestry Service, Pacific Forest Research Centre, Canada Dept. of Environment, Victoria, B.C. Information Report BC-X-69. 77 pp.

Duffield, J.W. 1970.

Silviculture need not be ugly. Jour. For. 68:8. 464-467.

Duffy, P.J.B. 1964.

Relationships between site factors and growth of Lodgepole Pine (*Pinus contorta* Dougl. car. *latifolia* Engelm.) in the foothills section of Alberta. Forest Research Branch, Ottawa. Canadian Dept. of Forestry Publication No. 1065. 60 pp.

Duffy, P.J.B. 1965.

A Forest Land Classification for the Mixed Wood Section of Alberta. Canadian Dept. of Forestry, Ottawa. Publication No. 1128. 23 pp.

SILVICULTURE

- _____ and Z. Nemeth. 1969.
A Forest Land Capability Classification for the East Slopes Area, Alberta. Forestry Branch, Dept. of Fisheries and Forestry, Forest Research Laboratory, Calgary, Alberta. Information Report A-X-20.
- Edey, C.E., and D. Hocking. 1971.
Pilot-scale rearing of tree seedlings in the BC/CFS styroblock and their planting in the foothills of Alberta 1970. Canadian Forestry Service, Dept. of Fisheries and Forestry, Forest Research Laboratory, Edmonton, Alberta. Internal Report A-45. 21 pp.
- Eis, Slavoj. 1965.
Development of White spruce and alpine fir seedlings on cut-over areas in the central interior of British Columbia. For. Chron. 41:4. 419-431.
- _____. 1966.
Survival and growth of White spruce wildlings and coastal nursery seedlings in the interior of British Columbia. For. Chron. 42:4. 346-349.
- _____. 1967a.
Establishment and early development of White spruce in the interior of British Columbia. For. Chron. 43:2. 174-177.
- _____. 1967b.
Cone crops of White and Black spruce are predictable. For. Chron. 43:3. 247-252.
- _____. 1970.
Root-growth relationships of juvenile White spruce, alpine fir, and Lodgepole Pine on three soils in the interior of British Columbia. Canadian Forestry Service, Department of Fisheries and Forestry, Ottawa. Publication No. 1276. 10 pp.

SILVICULTURE

1973.

Predicting White spruce cone crops. Forestry Service, Environment Canada, Pacific Forest Research Centre, Victoria, B.C. Technical Note. 4 pp.

Endean, F. 1971.

The effect of available rooting volume on the growth of Lodgepole Pine seedlings. Forest Research Laboratory, Edmonton, Alberta. Canadian Forestry Service, Dept. of Fisheries and Forestry. Internal Report A-42. 8 pp.

_____ and H.J. Johnson, and J.C. Lees. 1971.

Silvicultural Implications of large block clear cutting in Alberta. Pages 19-43 in Johnson et al. 1971 (see below).

Evans, David. 1973.

Establishment and survival of European Pine Shoot Moth on container-grown 1-0 Lodgepole Pine. C.F.S., Dept. of Environment, Victoria. Information Report B.C.-X-79. 7 pp.

Fowells, H.A. 1965 (editor).

Silvics of Forest Trees of the United States. U.S. Dept. of Agriculture, Washington, D.C. Agricultural Handbook No. 271. Forest Service. 762 pp.

Froning, K. 1972.

An appraisal of recent plantations in forests of the prairie provinces. Northern Forest Research Centre, Forestry Service, Environment Canada, Edmonton, Alta. Information Report NOR-X-31. 83 pp.

Gilmour, J.R., and J. Konishi. 1965.

Scarification in the Spruce-Alpine fir type of the Prince George Forest District. Forest Management Division, B.C. Forest Service, Victoria, B.C. Forest Management Note No. 4. 21 pp.

SILVICULTURE

- Glade, L. 1972.
Container Planting Program in Alberta. Forestry Service,
Environment Canada, Ottawa. Proceedings of a workshop on
container planting in Canada, pages 10-14. Information
Report DPC-X-2. 168 pp.
- Glew, D.R. 1963.
The results of stand treatment in the White spruce-alpine fir
type of the northern interior of British Columbia. Forest
Management Division, B.C. Forest Service, Victoria, B.C.
Note No. 1. 27 pp.
- Gimbarzevsky, Philip. 1966.
Land Inventory Interpretation. Photogrammetric Engineering,
Nov. 1966. 967-976.
- Griffith, B.G. 1931.
The natural regeneration of spruce in central British Columbia.
For. Chron. 7:4. 204-219.
- Haddock, Philip G. 1961.
Silvicultural views on the Canadian spruce forests. For.
Chron. 37:4. 376-389.
- Hagner, Stig. 1971.
Pinus contorta i norrlandskt skogsbruk. English summary.
Cultivation of Pinus contorta in northern Sweden.
Särtryck ur Sveriges Skogvårdsförbunds tidskrift, häfte 3.
219-246.
- Heinselman, M.L. 1957.
Silvical Characteristics of Black Spruce. Forest Service,
U.S. Dept. of Agric., St. Paul, Minn. Lake States Forest
Experiment Station. Station paper No. 45. 30 pp.
- Hellum, A.K. 1973.
Direct Seeding in Alberta. Alta. Forest Service.
Mimeo Report.

SILVICULTURE

- Holmes, John R.B., and David Tackle. 1962.
Height growth of Lodgepole Pine in Montana related to soil and stand factors. School of Forestry, Univ. of Montana, Missoula, Montana. Bulletin No. 21. 12 pp.
- Horton, K.W. 1953.
Causes of variation in the stocking of Lodgepole Pine regeneration following fire. Forestry Branch, Div. of Forest Research, Dept. of Northern Affairs and Nat. Res., Ottawa. Silvicultural Leaflet No. 95. 5 pp.
- _____. 1956.
The Ecology of Lodgepole Pine in Alberta, and its role in forest succession. Forestry Branch, Forest Research Div., Canada Dept. of Northern Affairs and Nat. Res., Ottawa. Tech. Note No. 45. 29 pp.
- _____. and J.C. Lees. 1961.
Black Spruce in the foothills of Alberta. Forest Research Branch, Canada Dept. of Forestry, Ottawa. Tech. Note No. 110. 54 pp.
- Hubbard, John W. 1972.
Effects of thinning on growth and yield. Aspen Symposium Proceedings. 126-30.
College of Forestry, Univ. of Minn. and Forest Service, U.S. Dept. Agriculture General Tech., St. Paul, Minn. Report NC-1. 154 pp.
- Illingworth, K., and J.W.C. Arlidge. 1960.
Interim report on some forest site types in Lodgepole Pine and Spruce-alpine fir stands. Forest Service, B.C. Dept. of Lands and Forests, Victoria, B.C. Research Note No. 35. 43 pp.
- Jarvis, J.M., G.A. Steneker, R.M. Waldron, and J.C. Lees. 1966.
Review of Silvicultural Research-White Spruce and trembling aspen cover types, mixedwood forest section, boreal forest region, Alberta-Saskatchewan-Manitoba. Canada Dept. of Forestry and Rural Development. Departmental Publication No. 1156. 189 pp.

SILVICULTURE

Johnson, H.J., and F. Marsh. 1967.

Preliminary evaluation of pilot-scale container planting in the foothills of Alberta. Forestry Branch, Canadian Dept. of Forestry and Rural Dev. Forest Res. Lab., Calgary, Alberta. Information Report A-X-11. 15 pp.

_____ and G. Dixon. 1968.

Preliminary Evaluation of Pilot-scale container Planting in the foothills of Alberta 1966 planting. Forestry Branch, Canadian Dept. of Forestry and Rural Dev., Forest Res. Lab., Edmonton, Alberta. Internal Report A-11. 14 pp.

Johnson, H.J., H.F. Cerezke, F. Endean, G.R. Hillman, A.D. Kiil, J.C. Lees, A.A. Loman, and J.M. Powell. 1971.

Some Implications of Large-Scale Clearcutting in Alberta: A Northern Literature Review. Northern Forest Research Centre, Canadian Forestry Service, Department of the Env., Edmonton, Alberta. Information Report NOR-X-6. 114 pp.

Johnstone, W.D. 1969.

Thinning young and old Lodgepole Pine stands in the subalpine region of Alberta. Forest Research Laboratory, Canadian Forestry Service, Dept. of Fisheries and Forestry, Calgary, Alberta. Internal Report A-25. 17 pp.

Kay, W.C., and D.L. Mitchell. 1971.

A Nursery Complex for Containerized Seedlings. Preliminary Report: Structures, Materials, Handling, Growing Sequences. Product Research and Development, Research Council of Alberta, Edmonton. 73 pp.

Kay, W.C. 1973.

Production Report. Alberta Forest Service Requirements for 1973-74. Product Research and Development, Research Council of Alberta, Edmonton. Seedling Production. 25 pp.

SILVICULTURE

Keays, J.L. 1972.

The Resource and Its Potential in North America. Aspen Symposium Proceedings, Pages 4-9.
College of Forestry, Univ. of Minn., Minn. For. Ind. Info. Comm., North Central For. Expt. Sta., Forest Service, U.S. Dept. of Agriculture, St. Paul, Minn. 154 pp.

Kennedy, Larry L. 1969.

Seed-From Collection to established Tree. For. Chron. 45:4. 421-427.

Knight, H., and P.J.B. Duffy. 1967.

A Forest Land Capability Classification for the Marsh Head Demonstration Area, Whitecourt Forest, Alberta. Forest Research Laboratory, Forestry Branch, Canada Dept. of Forestry and Rural Dev., Calgary, Alberta. Information Report A-X-10. 20 pp.

Krajina, V.J. 1965.

Ecology of Western North America. Department of Botany, Univ. of B.C., Vancouver, B.C. Vol. 1. 111 pp.

Lacate, D.S. 1966.

Wildland Inventory and Mapping. For. Chron. 42:3. 184-194.

1969.

Guidelines for Bio-Physical Land Classification. For classification of forest lands and associated wildlands. Canadian Forestry Service, Dept. of Fisheries and Forestry, Ottawa. Publication No. 1264. 61 pp.

, J.W.C. Arlidge, P.N. Sprout, and Alan Moss. 1965.

Forest Land Classification and interpretations for management in the spruce working circle, Tree Farm Licence No. 9, Okanagan Valley, B.C. Soil Survey Division, B.C. Dept. of Agriculture, Kelowna, B.C. A cooperative Interim Report. Mimeographed. 38 pp.

SILVICULTURE

Lawson, B.D. 1973.

Fire Behavior in Lodgepole Pine stands - related to the Canadian Fire Weather Index. Canadian Forestry Service, Pacific Research Centre, Canada Dept. of the Environment, Victoria, B.C. Information Report BC-X-76. 26 pp.

LeBarron, Russell K. 1952.

Silvicultural Practices for Lodgepole Pine in Montana. Northern Rocky Mtn. Forest and Range Experiment Station Forest Service, U.S. Dept. of Agric., Missoula, Montana. Station Paper No. 33. 19 pp.

Lee, J. 1967.

Stand models for Lodgepole Pine and limited to their application. Ph.D. Thesis, Faculty of Forestry, Univ. of B.C., Vancouver, B.C. 332 pp.

Lees, J.C. 1963.

Partial Cutting with Scarification in Alberta Spruce-Aspen Stands. Forest Research Branch, Canada Department of Forestry, Ottawa. Department of Forestry Publication No. 1001. 18 pp.

1964a.

Tolerance of White Spruce seedlings to flooding. Forest Research Branch Contribution No. 555. Forestry Chron. 40:2. 221-225.

1964b.

A test of harvest cutting methods in Alberta's spruce-aspen forest. Canadian Dept. of Forestry, Ottawa. Publication No. 1042. 19 pp.

1970.

Natural Regeneration of White Spruce under spruce-aspen shelterwood, B-18a Forest Section, Alberta. Department of Fisheries and Forestry, Ottawa. Department of Service Publication No. 1274. 14 pp.



SILVICULTURE

Leopold, L.B., F.E. Clarke, B.B. Hanshaw, and J.R. Balsley. 1971.
A procedure for evaluating Environmental Impact. U.S.G.S.,
Washington, D.C. Circular 645. 13 pp.

Lesko, G.L. 1971.
Early effects of a prescribed fire in spruce-fir slash on
some soil properties. Canadian Forestry Service, Forest
Research Laboratory, Department of Fisheries and Forestry,
Edmonton, Alberta. Internal Report A-44. 12 pp.

Litton, R. Burton, Jr. 1968.
Forest Landscape Descriptions and Inventories - a basis for
land planning and design. Summary report on cooperative
agreement. Forest Service, U.S.A. Agri. and College of
Environmental Design, Univ. of Calif., Berkeley, Calif.,
Pacific Southwest Forest and Range Experiment Station,
Berkeley, Calif. Research Paper PSW-49. 64 pp.

Lotan, James E. 1964.
Regeneration of Lodgepole Pine: A Study of slash disposal and
cone opening. Intermountain Forest and Range Experiment
Station, Forest Service, U.S. Dept. Agriculture, Ogden, Utah.
Research Note INT-16. 4 pp.

1967.

Cone Serotiny of Lodgepole Pine near West Yellowstone, Montana.
Forest Science 13:1. 55-59.

1968.

Cone Serotiny of Lodgepole Pine near Island Park, Idaho.
Forest Service, Intermountain Forest and Range Experiment
Station, U.S.A. Agri., Ogden, Utah. Research Paper INT-52.
6 pp.

and Chester E. Jensen. 1970.

Estimating Seed stored in serotinous cones of Lodgepole Pine.
U.S.D.A. Forest Service, Intermountain Forest and Range
Experiment Station, Ogden, Utah. Research Paper INT-83.
Page 10.

SILVICULTURE

1973.

Special computer sheet bibliography, cone serotiny, Lodgepole Pine.

McDougall, F.W., and L.L. Kennedy. 1972.

The status and future of reforestation in Alberta.
Reprint from Pulp and Paper Magazine of Canada for March 1972.
8 pp.

McMinn, R.G. 1972. (editor)

White Spruce: The Ecology of a Northern Resource. Proceedings of a Symposium held June 21, 1971. Canadian Botanical Asscn. Edmonton, Alberta. Northern Forest Research Center, Canadian Forestry Service, Dept. of the Environment, Edmonton, Alta. Information Report NOR-X-40. 44 pp.

Melekhov, I.S. 1960a.

The nature of the Taiga Forests and cutover areas.
Pages 265-273, in Questions of Forestry and Forest Management. (Papers for the V World Forestry Congress at Seattle, 1960). The USSR Academy of Sciences, Moscow. 476 pp.

1960b.

Timber Harvesting and Regeneration in the North. (In Russian)-partial translation by Prof. J. Solecki, University of B.C. - unpublished mss.). Archangel Book Publishing Co. 199 pp.

Mirov, N.T. 1956.

Composition of turpentine of Lodgepole and Jack pine hybrids. Canada Journ. Bot. 34. 443-457.

Moss, E.H. 1955.

The Vegetation of Alberta. The Botanical Review 21:9. 493-567.

1959.

The Flora of Alberta. A Manual of flowering plants, conifers, ferns and fern allies found growing without cultivation in the province of Alberta, Canada. Univ. of Toronto Press. Reprinted 1964 in U.S.A. 546 pp.

SILVICULTURE

Nienstaedt, Hans. 1957.

Silvical characteristics of White Spruce. Lakes States Forest Experiment Station, Forest Service, U.S. Department of Agriculture, St. Paul, Minn. Station Paper No. 55. 23 pp.

Nordin, V.J. 1957.

Diseases of Lodgepole Pine in Alberta. Forest Biology Lab., Canada Dept. of Agriculture Science Service, Forest Biology Division, Calgary, Alberta. 28 pp. plus plates.

Osborne, J.E. 1968a.

Influence of stocking and density upon growth and yield of trees and stands of coastal western hemlock. Ph.D. Thesis, Faculty of Forestry, Univ. of B.C., Vancouver. Mimeographed. 396 pp.

1968b.

Economics of Spacing Control. Faculty of Forestry, Univ. of B.C. Mimeographed Report for Forestry 581. 109 pp.

Prochnau, A.E. 1963.

Direct Seeding Experiments with White Spruce, alpine fir, Douglas fir, and Lodgepole Pine in the central interior of B.C. B.C. Forest Service, Victoria, B.C. Research Note No. 37. 23 pp.

Rehfeldt, G.E., and J.E. Lotan. 1970.

Pinus contorta and *banksiana* hybrids tested in northern Rocky Mountains. Forest Service, U.S. Dept. of Agriculture, Inter-Mountain Forest and Range Experiment Station, Ogden, Utah. Research Note INT-126. 7 pp.

Revel, John. 1971.

Silviculture in spruce-alpine for types in the North Central Interior of B.C. Problem Analysis. Research Division, E.P. 639. B.C. Forest Service, Prince George, B.C. Typewritten manuscript - unpublished. 49 pp.



SILVICULTURE

Robinson, Fred C. 1973.

Forest Regeneration in Ontario. Pulp and Paper Magazine of Canada, Woodlands Section 74:2. 29-32 & 35.

Roche, Laurence. 1970.

The silvicultural significance of Geographic Variation in the white-Engelmann spruce complex in B.C. Forest Chron. 46. 116-125.

Roe, Arthur L., and Gene D. Amman. 1970.

The mountain pine beetle in Lodgepole Pine forests. Forest Service, U.S.D.A., Intermountain Forest and Range Experiment Station, Ogden, Utah. Research Paper INT-71. 23 pp.

Roe, A.L., and G.M. DeJarnette. 1965.

Results of Regeneration cutting in a spruce-subalpine fir stand. Forest Service, U.S.D.A., Intermountain Forest and Range Experiment Station. Research Paper INT-17. 14 pp.

Rowe, J.S. 1959.

Forest Regions of Canada. Forestry Branch, Canada Dept. of Northern Affairs and Nat. Resources, Ottawa. Bulletin 123. 71 pp. with map.

1961.

Critique of some vegetational concepts as applied to forests of Northwestern Alberta. Canadian Journal of Botany 39. 1007-1017.

1970.

Spruce and Fire in Northwest Canada and Alaska. Pages 245-253 in Annual Proceedings. Tall Timbers Fire Ecology Conference, Aug. 20-21, 1970, Fredericton, N.C. Tall Timbers Research Station, Tallahassee, Florida. 336 pp.

Sandwell, P.R. 1966.

Research visit to the U.S.S.R. Sandwell and Co. Ltd., Vancouver, B.C. 91 pp. with map.

SILVICULTURE

- Schreiner, Ernest J. 1970.
Minirotation Forestry. Forest Service, U.S.D.A. North-
eastern Forest Experiment Station, Upper Darby, Pa. Research
Paper NE 174. 32 pp.
- Schubert, Gilbert H., and Roland S. Adams. 1971.
Reforestation Practices for Conifers in California. Division
of Forestry, State of Calif., Sacramento, Calif. 359 pp.
- Shoup, J.M., L.D. Nairn, and R.H.M. Pratt. 1968.
Forest Research Laboratory, Winnipeg, Manitoba., Dept.
of Forestry and Rural Development. Trembling Aspen
Bibliography Liaison & Services Note MS-L-3.
- Shuzhmov, A.A. 1972.
The economics of different methods of regeneration in
northern taiga forests. Lesnoi Zhurnal 1972 15(4). 150-155.
Ru, 12 ref. Not Seen-only Forestry Abstract read-as given
(05104 1/34, 187x166(472) plus 174.7 Picea abies and 174.6
Pinus sylvestris plus 651.72).
- Smithers, L.A. 1956.
Assessment of site productivity in dense Lodgepole Pine stands.
Forest Research Div., Forestry Branch, Canada Dept. of North.
Affairs and Nat. Res., Ottawa. Tech. Note No. 30. 20 pp.
- _____. 1962.
Lodgepole Pine in Alberta. Canada Dept. of Forestry, Ottawa.
Bulletin 127. 153 pp.
- Smith, J.H.G. 1955.
Some factors affecting reproduction of Engelmann spruce
and alpine fir. Research Division, B.C. Forest Service,
Victoria, B.C. Technical Pub. T43. 43 pp.
- _____. and Gordon R. Bailey. 1964.
Influence of stocking and stand density on Crown widths of
Douglas fir and Lodgepole Pine. Commonwealth Forestry
Review 43:3. No. 117. 243-245.



SILVICULTURE

Smith, R.B., and H.M. Craig. (undated)

"Decay in Advanced Alpine Fir Regeneration in B.C. and its Bearing on Stand Management. I. In the Sub-Boreal Zone (Prince George District)." -Not Seen-but basis for "Timber Talks" Note No. 32, by V.H. Phelps-"What Value is Alpine fir advance Growth?" Mimeo undated release 1 page. Forest Research Laboratory, Canada Department of Forestry, Victoria, B.C.

Smyth, J.H., and B.W. Karaim. 1972.

An economic analysis of Reforestation Costs in Alberta. Northern Forest Research Centre, Forestry Service, Environment Canada, Edmonton, Alberta. Information Report NOR-X-41. 51 pp.

Soos, J. 1967.

First year mortality of container planting in the Clearwater-Rocky Mountain House Forest. Forest Research Laboratory, Canada Dept. of Forestry and Rural Development, Calgary, Alta. Alberta Information Report A-X7. 41 pp.

Soos, J., and T.C. Mueller. 1970.

Success of scarification and seeding in Clearwater-Rocky Forest, Alberta. Forest Research Laboratory, Canadian Forestry Service, Department of Fisheries & Forestry, Edmonton, Alta. Internal Report A-32. 24 pp.

Stanek, Walter. 1966.

Occurrence, growth, and relative value of Lodgepole Pine and Engelmann spruce in the Interior of B.C. Ph.D. Thesis, U.B.C. Faculty of Forestry, Vancouver, B.C. 267 pp.

1966.

Relative Quality of the Major Forest Association of the Southern B.C. Interior for Growth of Lodgepole Pine, Engelmann spruce, Douglas fir and alpine fir. For. Chron. 42:3. 306-313.

SILVICULTURE

- Sutton, R.F. 1969.
Silvics of White Spruce. Dept. of Fisheries and Forestry,
Ottawa. Forestry Branch Publication No. 1250. 57 pp.
- Sziklai, Oscar. 1972.
Plus tree selection of *Pinus contorta* var. *latifolia* in
central B.C. Faculty of Forestry, Univ. of B.C., Vancouver.
Stora Kopparberg 67-7297-1971/72. Pages not numbered.
- Tackle, David. 1959.
Silvics of Lodgepole Pine. Forest Service, U.S.D.A.,
Intermountain Forest and Range Experiment Station, Ogden, Utah.
Misc. Pub. No. 19. 24 pp.
-
1964.
Regenerating Lodgepole Pine in central Montana following
clear cutting. U.S. Forest Service, U.S.D.A., Intermountain
Forest and Range Experiment Station, Ogden, Utah. Res. Note
INT-17.
-
- and D.I. Crossley. 1953.
Lodgepole Pine Bibliography. Forest Service, U.S.D.A.,
Intermountain Forest and Range Experiment Station, Ogden,
Utah. Res. Paper No. 30. 57 pp.
-
- and Raymond C. Shearer. 1959.
Strip-thinning by bulldozer in a young Lodgepole Pine stand.
Proceedings of the Montana Academy of Sciences 19. 142-148.
- United States Forest Service. 1961.
Forestry and Forest Industry in the USSR. Forest Service,
U.S. Department of Agriculture, Washington, D.C.
Report of a Technical Study Group. 92 pp.
-
1965.
Forest Patterns-Beauty and Use. Forest Service, U.S.D.A.
PA-679. Washington, D.C. Based on a visual presentation
at the 36th Annual Convention of the National Council of
State Garden Clubs, Portland, Oregon, May 25, 1965. 11 pp.



SILVICULTURE

1968.

Forest Service Manual: Title 2400. Timber Management Region 6 Supplement No. 68. (Re: Landscape Management Units, Environmental Silviculture, Watershed management aspects etc.) U.S. Forest Service. Mimeographed. 49 pp.

1972a.

Handbook on the Visual Management System. By Warren R. Bacon, and Paul F. Hansen, Landscape Architects of Region 6, U.S. Forest Service, Portland, Oregon. 63 pp., plus 6 page glossary.

1972b.

Aspen Symposium Proceedings. Forest Service, U.S.D.A., North Central Forest Experiment Station, St. Paul, Minn. General Technical Report NC-1. 154 pp.

Vincent, A.B. 1965.

Black spruce. A Review of its silvics, ecology, and silviculture. Canada Department of Forestry, Ottawa. Publication No. 1100. 79 pp.

Wagg, J.W. Bruce. 1964.

White spruce regeneration on the Peace and Slave River Lowlands. Forest Research Branch, Canada Department of Forestry, Ottawa. Department of Forestry Publication No. 1069. 35 pp.

Waldron, R.M. 1972.

Proceedings of a Workshop on Container Planting in Canada. Canadian Forestry Service, Department of the Environment, Ottawa. Information Report DPC-X-2. 168 pp.

Wikstrom, John H., and Charles A. Wellner. 1961.

The opportunity to thin and prune in the northern Rocky Mountain and Intermountain Regions, Forest Service, U.S.D.A., Intermountain Forest and Range Experiment Station, Ogden, Utah. Research Paper 61. 14 pp.



SILVICULTURE

Wilm, H.G., and E.G. Dunford. 1948.

Effect of Timber Cutting on Water available from Stream flow from a Lodgepole Pine forest. Forest Service, U.S.D.A., Washington, D.C. Technical Bulletin No. 968. 43 pp.

Yeatman, C.W., and A.H. Teich. (undated)

Genetics and Breeding of Jack and Lodgepole Pines in Canada. Forest Chronicle 45:4. 428-433.

Zahner, Robert, and Ned A. Crawford. 1963.

The clonal concept in aspen site relations. In Forest soil relationships in North America. Cornvallis, Oregon, State University Press. Chester T. Youngberg, Ed. 228-243, illus.

LAND USE AND RESOURCE DEVELOPMENT

Alberta Forest Products Association. 1973.

Submission on integrated land use and resource development in the Eastern Slopes. A.F.P.A. Circular 27-73. 6 pp.

Alberta Wilderness Association. 1973.

Wildlands for recreation. 123 pp.

Conservation and Utilization Committee Task Force on the East Slopes Hearings. 1973.

The resources of the Foothills: a choice of land use alterations. Background document programs for Environment Conservation Authority. 43 pp.

Department of the Environment of Canada. 1973.

Land Use and resource development in the East Slopes of Alberta. Brief submitted to E.C.A. 23 pp., with background papers separately bound.

Environment Conservation Authority, Alberta. 1973.

Commercial proposals for tourism and recreation to be presented at the public hearings on land use and resource development in the Eastern Slopes. E.C.A. Information Bulletin No. 4. 23 pp.

Peace River Regional Planning Commission. May, 1973.

Land use and resource development in the Eastern Slopes-Smoky River Drainage Basin. E.C.A. Information Bulletin No. 8. 37 pp.

Peace River Regional Planning Commission. July, 1973.

Land use and resource development on the Eastern Slopes-Smoky River Basin. Submission to E.C.A. 43 pp. Mimeo.

Provincial Planning Branch, Dept. of Municipal Affairs. 1973.

Land use and resource development in the Eastern Slopes-Athabasca-Yellowhead Area. E.C.A. Information Bulletin No. 9.

LAND USE AND RESOURCE DEVELOPMENT

Wild Kakwa. July, 1973.

A submission to the Environment Conservation Authority for the establishment of a wilderness area and a restricted development area in the Kakwa Falls region of West/Central Alberta. 18 pp. Mimeo.

ENVIRONMENTAL IMPACT

Leopold, L.B., F.E. Clarke, B.B. Hanshaw, and J.R. Balsby. 1971.
A procedure for evaluating Environmental Impact. U.S.G.S.,
Washington, D.C. Circular 645. 13 pp.



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APPENDIX V-2

GLOSSARY

APPENDIX V-2

GLOSSARY OF ABBREVIATIONS AND TERMS

A.D.T.	Air-dried tons
A.D.T.P.D.	Air-dried tons per day (commonly T.P.D.) (T.P.A. tons per annum)
A.M.V.	Average market value
A.O.P.	Annual operating plan covers road and cutting developments, reforestation, site preparation and other forest management activities for one year
Ablation till	A mixture of rocks and rock flour carried by glacier and deposited at its melting point
Aeolian soil	Wind deposited soil
Aesthetics	The impact on human sense perception, particularly related to the general public
Age class distribution	The local occurrence of age classes of trees or the representation of different age classes in a forest
Alevin	A newly hatched fish which retains its yolk sac and has not left the spawning bed
Allowable annual cut - AAC	The volume of wood that may be removed from a properly managed area every year
Alluvium	Water transported and deposited materials
Anticlinal	Relating to upward arching strata of rock
Archaeological site	Where evidence of prehistoric occupation by man has been found

Biotic	Relating to life
Block	A major administrative division of the forest usually based on topography and including several compartments and logging chances
Bone-dry unit	2,400 lbs of bone-dry wood chips or the equivalent volume of wood in green chips
Boreal	Relating to or growing in the northern and mountainous parts of the northern hemisphere
Borrow pits	Areas used for the removal of sand and gravel for road building purposes
Browse	Tender shoots, twigs and leaves of trees and shrubs suitable to be eaten by cattle and wildlife
Buffalo jump	A steep cliff over which buffalo were driven by Indian hunters
C C.F.	Cunit - see below
C.F.S.	Canadian Forest Service
c.f.s.	Cubic feet per second
Carnivore	Feeding on animal substance
Cenozoic	Era succeeding Paleozoic and Mesozoic geological eras
Classical Wisconsin	A period 12,000-24,000 years ago associated with continental glaciers
Clearcutting	Removal of all merchantable timber from cutover area
Climax species	The species capable of perpetuation under the prevailing climatic and edaphic conditions, the terminal stage of a sere
Colluvium	A heterogeneous mixture of soil and rock materials on lower slopes resulting chiefly from the transporting action of gravity

Committed annual cut	That portion of the annual cut which has been allocated to specific operators
Compartment	An organization unit or small subdivision of forest for purposes of orientation, administration and silviculture defined by permanent boundaries either of natural features or artificially marked
Competent (road building material)	Material which can meet demands of road standard to be constructed
Coniferous	Belonging to the order Coniferae, usually evergreen with cones and needle-shaped and producing wood known commercially as "softwood". Tamarack and alpine larch shed their needles in the winter but are still coniferous.
Cord	85 cubic feet of solid wood occupying 128 cubic feet of space in stacked roundwood
Cordilleran	The Rocky Mountains
Cunit (C C.F.)	100 cubic feet of roundwood or equivalent in processed form
Cutting cycle	The planned interval for cutting of the mature stands within an operating area or compartment
D.O.E.	Department of the Environment
Dead shade	Shade provided by snags, debris or other non-living matter (as distinguished from live shade from competing vegetation)
Deciduous	Trees that shed their leaves each winter. The term used to designate the class of broad-leaved trees known commercially as "hardwoods"
Demographic	Relating to the statistical study of human populations
Diameter limit cutting	Removal of merchantable trees over a specified DBH (diameter outside bark at 4.5 feet above ground level)

Ditch blocks	Obstructions across ditch to restrict velocity of water to reduce erosion and sediment load
Ditch - off take	Subsidiary ditches to divert flow from main ditch into adjacent land
Ditch - unbuffered	Ditch with no restriction to flow of water and sediment load
Duff	Forest litter and other organic debris in various stages of decomposition on top of the mineral soil
Edaphic	Relating to the plant growing properties of soils
Evapotranspiration	Loss of water from the soil through transpiration by plants and direct evaporation from the soil surface
Extractive industries	Industries engaged in harvesting natural resources, i.e., mining, timber and petroleum
F.M.A.	Forest Management Area - see below
F.R.A.	Forest Recreation Area - area set aside by A.F.S. for public recreational use
Fire Weather Index	An index based on measurement of weather and/or fuel conditions and used to assess fire hazard
Foot, board (f.b.m.)	A unit of measurement represented by a board 1 foot long, 1 foot wide and 1 inch thick. Abbreviated to f.b.m. (foot board measure). In practice the working unit is 1,000 board feet (M B.M.) or 1,000,000 board feet (MM B.M.).
Foot, cubic	A cube 12 inches on each side. A cubic foot of wood is considered to contain from about 4 to 10 board feet depending on natural and manufacturing losses. In Alberta a conversion factor of 1 cubic foot equals 5.29 board feet has been used for inventory conversions.

Forbs	Herbs other than grasses
Forest land - non-productive (NP)	Land which is incapable of or not likely to produce timber of commercial value. This includes land under water, muskegs both open and wooded, cultivated lands, hay and grass meadows, permanent brush areas, barren lands above tree line, areas where trees are stunted due to elevation and rock barrens.
Forest land - potentially productive (PP)	Land capable of producing commercial forest crops. It includes lands that were and could again be commercially productive if seeded, planted or otherwise treated.
Forest land - productive	Land which is presently producing timber crops that are merchantable or will develop into merchantable stands.
Forest Management Area - F.M.A.	An area allotted to one company under lease for timber harvesting purposes for a continuing period.
Gabion	A heavy wire mesh basket filled with coarse gravel used for prevention of water erosion
Glacial ablation	Melting and runoff from a glacier
Glaciofluvial	Pertaining to streams of glacial melt water or deposits made by them
Growing season	Period of year during which mean daily temperature exceeds 42°F
Gully block	Constructed under road surface when route crosses gully. It consists of tree trunks and brush which will allow slow percolation of water through the road bed.
Habitat	The place or type of site where a plant or animal naturally or normally lives and grows
Hydrophilic	Water loving

Indurate	To harden
Key ranges	Important wintering areas for ungulate big game. Habitat necessary to the local populations of caribou and grizzly bear.
Killing frost	28°F
LO	License of Occupation - see below
L.O.	Forest Service lookout for fire detection
Lacustrine	Produced by or belonging to lakes
Land capability	The suitability of land for supporting various functions, i.e., timber harvesting, wildlife habitat, recreation, etc.
Land Conservation Guidelines	Guidelines produced by the Alberta Department of the Environment
Leader	Stem growth in past growing season
License of Occupation	LO - issued by Director of Lands, Department of Lands and Forests for special occupation rights on public lands
Lithology	The study of rocks
Logging chance	The degree of ease and profitability with which a given locality can be harvested
M	Suffix meaning "times one thousand"
MM	Suffix meaning "times one million"
M.A.I.	Mean Annual Increment - see below
Management Plan	Report giving description of the area and circumstances, forest inventory, allowable cut figures, long-term development plans, harvesting, silvicultural and administrative measures

Mean annual increment	The total stand volume at specified age divided by that age
Mesic	Moderately moist
Mesozoic	Geological era between Paleozoic and Cenozoic eras
Microclimate	The atmospheric conditions existing in or immediately surrounding a small area or locality such as a nursery bed, or a patch of reproduction. Use of the term implies wide variation over short distances
Micronutrient	Nutrient necessary in very small amounts for the health of the plant
Milacre	A plot of 1/1000 acre (usually 1/10 chain square) used in reproduction or vegetation surveys
Mineral lick	A place (often a spring) having surface mineralization where animals regularly lick
Monoculture	Growth of single tree species to the exclusion of all other species
NP	Non-productive forest land - see Forest land
NSR	Not satisfactorily restocked
Oligocene	A series in the Paleozoic era of geology
Omnivore	Feeding on both animal and vegetative substances
Orographic	Of or relating to mountains
Overlanders	Those who travelled overland to the B.C. goldfields as opposed to those who travelled by sea round Cape Horn
Paleozoic	Early era of geologic time characterized by relative abundance of marine organic remains. Limestone strata are common.

Photoperiod	Relative length of day and night and its effect on the growth of a plant
Phytogeographic zone	A zone characterized by a homogenous plant distribution
Pre-cambrian	Earliest era of geological history
Putting-to-bed	Preparation of a road for a period of disuse, by means of cross ditching, blocking of entry or other measures to prevent erosion or unauthorized traffic. Re-use at a later date is implied.
R/W	Right-of-way
Red belt	Damage to trees rooted in frozen soil caused by excessive transpiration during winter, usually brought on by Chinook winds. The affected areas are often sharply delineated.
Riparian	Relating to the banks of a natural watercourse
Rip rap	Stones dumped without order on a slope to prevent erosion
Riverine	Relating to, formed by or resembling a river
Rotation	The period of years required to establish and grow timber crops to a specified condition of maturity. Several types of rotation are recognized depending on the economic, silvicultural or technical factors involved.
Roundwood	Logs or pulpwood before processing
S.R.	Satisfactorily restocked
Salmonids	Members of the Salmonideae family of fish

Sanitation cutting	The cutting of infected or infested material for the purpose of reducing disease and insect incidence in the forest
Scarify (forest floor)	To break up the forest floor and topsoil preparatory to natural regeneration or direct seeding
Seismic lines	Cut lines providing access to prearranged sites for geophysical observations
Sere	The series of stages which follow one another in an ecologic succession
Serotinous cones	Cones which remain closed until high temperatures are applied
Silviculture	The art of producing and looking after a forest; the application of the knowledge of growth habits and characteristics to the treatment of a forest
Site	a. An abstract term indicating the combination of all factors that contribute to the growing capacity of an area to produce forests, including the biotic, climatic and edaphic conditions of the area b. The location of a structure or an activity
Skyline concept	The protection of the skyline by siting of powerlines, clearcuts and other interference below crest of hill
Slash	Debris remaining after logging
Snowpack	Packed snow which normally melts slowly to yield water for the summer months
Soil horizon	Recognizable strata of soil A horizon - organic B mineral but with leached solutes C sterile subsoil



Spelunking	Exploration of caves
Standard deviation	Statistical measure of dispersion about mean value
Storm intensity	Expressed in inches of precipitation per hour
Story, over-	Upper vegetation canopy (dominant and co-dominant trees)
Story, under-	Layer of suppressed trees
Story, shrub-	Layer of taller shrubs
Story, ground-	Herbs, ferns, mosses, lichens and low shrubs
Story, middle-	Combined under- and shrub stories
Stumpage	The value of timber as it stands uncut in the woods and thus payable to its owner for cutting rights
Subdominant	An ecologically important life form subordinate in influence to the dominants of a community
Successional (plants)	Relating to the progressive development of the vegetation towards its highest ecological expression, the climax. The replacement of one plant community by another.
Syncline	A trough of stratified rock in which the beds dip towards each other from either side
Tertiary	Geological period preceding Pleistocene epoch (recent)
Thrust fault	A fault in which the upper rock strata have been pushed forward over the lower strata, the upthrow being on the dip side of the fault plane. It may be formed by the breaking of an overturned fold at the sharply bent crest of the anticline



Tubelings	Seedlings grown in tube type containers
Turbid	Clouded with suspended sediment
Von Mantel Formula	Formala for calculation of allowable annual cut, based on volume control: $AAC = G/0.5R$ where G = total growing stock volume, mature and immature R = rotation
W.M.U.	Wildlife Management Unit
Working Circle	The primary unit of forest management with well defined boundaries, usually based on topography, large enough to furnish a sustained yield of forest products each year in the rotation

